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DEPARTMENT OF AGRICULTURE
ANNUAL REPORT, 1938

Volume I

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ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, 1938

Volume I

PART I—AGRICULTURE IN KENYA IN 1938

Weather

(For the following notes on the weather the Director of Agriculture is indebted to the Director of the British East African Meteorological Service.)

In the Trans Nzoia rainfall was below average in the first half (April and May) of the rainy season, but above average from June to September. January was unusually wet (plus 143 per cent) and February dry (minus 82 per cent).

In Kavirondo the rains were generally good. The greatest departures from average were July (plus 30 per cent) and February (minus 76 per cent).

West of the Rift there was a shortage during the first half of the rainy season, April being 50 per cent below average, but June to September were consistently above average. January and December were comparatively wet, and February and November dry.

East of the Rift the "long rains" of March to May were 24 per cent below average, while the "short rains" of October to December were 9 per cent above average. January was comparatively wet, being 75 per cent above average, while February and June were very dry.

In the Rift only July, August and December were above average, with plus 7 per cent, plus 35 per cent and plus 35 per cent respectively, the wet months of April and May being 35 per cent below average.

In the main coffee areas rainfall was continuously below average from February to October; the "long rains" of March to May were 25 per cent below average, but a wet December brought the "short rains" of October to December up to 12 per cent above average.

On the coast during the rainy season of April to June rainfall was 30 per cent above average, and for the dry season of January and February it was 65 per cent below average.

The rainfall for the year throughout the Colony was slightly below average, the main shortfall being in the "long rains" of March to May east of the Rift and in the first half of the mid-year rains over the western half of the Highlands.

A table of percentage departures from average rainfall is shown below for each of the main agricultural areas:—

PERCENTAGE DEPARTURES FROM AVERAGE IN THE
MAIN AGRICULTURAL DISTRICTS
1938

Agricultural Districts	Trans Nzoia	Kavirondo	West Rift	East Rift	Rift	Main Coffee Areas	Coast
No. of Stations	18	18	14	13	25	—	—
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
January	+143	0	+40	+75	-15	+14	-60
February	-82	-76	-85	-62	-82	-23	-75
March	-20	+15	-11	-56	-44	-16	+9
April	-50	-12	-59	-20	-52	-34	+10
May	-9	-10	-3	-11	-18	-19	+74
June	+10	+4	+1	-71	-31	-83	-36
July	+21	+30	+30	+15	+7	-32	0
August	+34	-1	+12	+3	+35	-10	-5
September	+14	+13	+6	-12	-15	-46	-36
October	-18	+17	-27	-10	-6	-6	+32
November	-37	-2	-45	+1	-38	+2	-2
December	+11	-33	+45	+48	+35	+43	+19
YEAR	-4	-4	-8	-11	-18	-13	+13

General

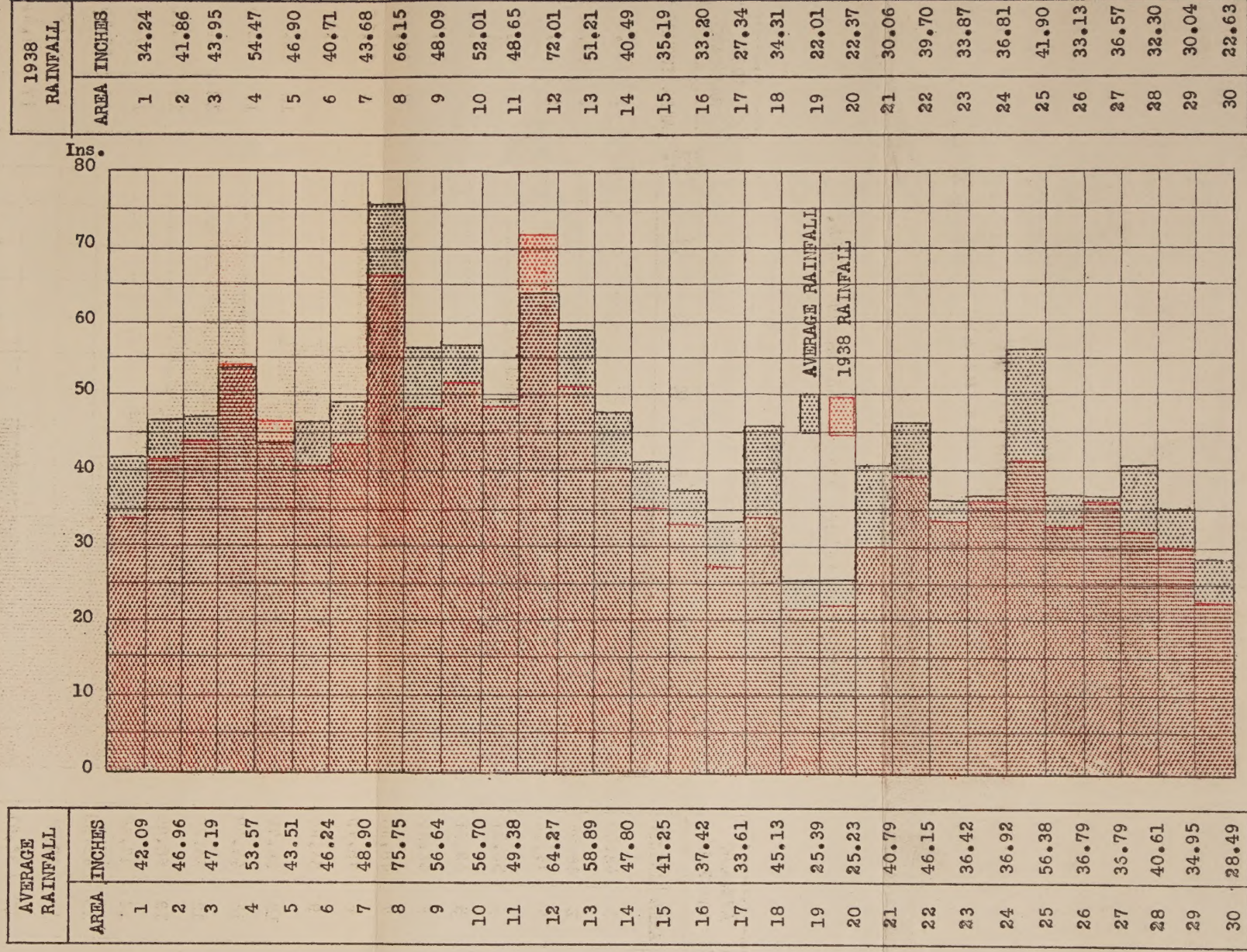
Prices and Crops

The lowering of the general level of wholesale prices, which began about the middle of 1937, was not corrected in 1938. The price of maize remained fairly steady, but declined somewhat towards the end of the year. The prices of sisal and wheat were poor, the former remaining steady, but at a lower level than in 1937; the latter declining steadily. From May onwards the price of tea declined slightly, but partly recovered at the end of the year. Cotton prices remained at a low level, and a considerably reduced crop was grown in the 1938-39

GRAPHICAL REPRESENTATION OF THE RAINFALL FOR THE YEAR 1938

OVER THE AGRICULTURAL CENSUS AREAS AS COMPARED WITH

THE AVERAGE RAINFALL FOR A NUMBER OF YEARS.



season. Coffee prices rose towards the end of the year. The prices of pyrethrum and passion fruit juice remained steady, and the cultivation of these crops increased.

A disease of passion fruit vines known as "woodiness disease" caused considerable concern. Dr. Storey, of the East African Research Station, Amani, Tanganyika Territory, and Dr. Nattrass, the Senior Plant Pathologist of this Department, are now investigating this disease and its control, in collaboration.

New Crops—European

New crops which are attracting the increasing attention of European farmers are flax (both for the production of pedigree seed and of fibre), oyster nuts (*Telfairia pedata*), derris root, tobacco for nicotine production, and cascara bark. None of these crops is yet produced in an appreciable quantity.

Mixed Farming

It can be recorded that mixed farming is becoming more general in those European areas which are suited to it. In native areas great progress has been achieved by the encouragement of mixed farming in the Central Province. In the Nyanza and Coast Provinces, although mixed farming propaganda is being increased, little progress can yet be recorded.

Crop Improvement

In addition to this direction of progress in native areas, improvement continues to be made, through breeding, selection and importation, in the quality of crops grown. Notable recent examples are Dobbs and Kano sorghums, Durum maize, Bukara eleusine millet, New Era pigeon peas, Peshawari and Basmati rice, and Malindi cassava. In European areas work continues on the improvement of wheat, maize, and pyrethrum strains. The breeding work with wheat is partly for the maintenance of rust resistance; without this the wheat industry could not continue to exist, and the fact of its continued existence is testimony to the success of the work. Later sections of this report give extended information on this work for crop improvement.

Soil Control

The study and application of anti-soil-erosion measures are important items of the Department's work. The Agricultural Officer in charge of Soil Conservation Services completed soil erosion and land utilization surveys of the Nyanza Province and the Meru District early in the year. From May

onwards he was absent from Kenya on a visit to the United States of America to study soil control work there. Advice on soil control measures was given to farmers throughout the European areas. In the native reserves much progress was made in protection against erosion of existing cultivated land, reclamation of already eroded areas, protection of water-courses, construction of dams and in reclamation of swamps. In the Machakos Reserve soil conservation work was continued under the supervision of the Soil Engineer.

Flax Fibre

Mr. J. Megaw, a flax expert from the Ministry of Agriculture, Northern Ireland, visited Kenya for the purpose of reporting on the possibility of re-establishing the flax fibre industry. The cost of his visit was met by a grant from the Colonial Development Fund. Mr. Megaw recommended the re-establishment of this industry and a substantial grant from the Colonial Development Fund.

Sisal Experiment Station

Work was begun on the establishment of a high-level sisal research station at Thika. The cost of establishment is estimated at £8,000, of which half will be met by a grant from the Colonial Development Fund, the balance being paid from the proceeds of the cess on sisal exports.

Pyrethrum Ordinance

The old Pyrethrum Ordinance was repealed by the Pyrethrum Ordinance, 1938, which is aimed at greater control of the industry. Under this Ordinance a new Board with wider powers was established early in 1939, and growers have now to be licensed. The Board may recommend the refusal of licences in respect of new or increased acreages, but the Director of Agriculture has the right of veto. Applicants have the right of appeal to His Excellency the Governor.

Tea Acreage

An extra tea acreage was allotted to Kenya, and was allocated to existing areas and to new areas in Kaimosi, Nandi and Sotik.

Five-year Coffee Plan

A five-year plan for the organization of the coffee services was introduced. Under this plan, Government agreed to pay to the Coffee Board of Kenya the proceeds of coffee plantation licences, in return for which the Coffee Board agreed to contribute £1,200 per annum towards the cost of the coffee services.

Locusts

Kenya was invaded by swarms of the African Migratory or Hairy-chested Locust (*Locusta migratoria migratorioides*) in the last four months of the year. A description of this invasion will be found in this report.

Soil Erosion

Dr. Pole-Evans, the Chief of the Plant Industry Division of the Agricultural Department of the Union of South Africa, visited Kenya at the invitation of the Kenya Government in July, with the special object of seeing the eroded areas of this country. He and his staff travelled over the greater part of the agricultural and ranching areas of Kenya in a self-contained *safari* unit. After his return to South Africa he published a report on his visit.

In March and April the Agricultural Officer in charge of Grassland Research visited the Union of South Africa in company with the Acting Deputy Colonial Secretary and this Department's Soil Engineer, in order to investigate methods of soil conservation developed in the Union.

Wheat

Mr. Lathbury, Plant Breeder (now Senior Plant Breeder), at the request of the Government of Tanganyika Territory, visited the Southern Highlands of Tanganyika in June and the Northern Highlands in August, to advise on wheat-growing in those areas.

Agricultural Credit

During the year 1938 £50,000 further capital was drawn for Land Bank purposes, bringing the total capital to £720,000. New long-term loans, numbering 75 and totalling £77,739, were issued, also 52 short-term loans aggregating £11,710. Twenty-six long-term loans aggregating £30,850 and fourteen short-term loans aggregating £3,410 were repaid completely. At 31st December, 1938, 682 long-term loans totalling £832,189 and 152 short-term loans totalling £34,733 had been issued.

The Central Agricultural Advances Board was continued in operation. Interest charges on advances ceased as from 1st January, 1938, and efforts are being made to wind up the scheme.

The Farmers' Conciliation Board dealt with eleven further applications during the year, of which five were approved.

Three were rejected, one withdrawn, and two remained under consideration. The total of advances authorized during 1938 was £17,459, distributed among thirteen applicants.

Marketing

Considerable progress was made with marketing and inspection services in native areas during the year. In most cases these services are self-supporting. No fewer than 1,344,726 200-lb. bags of produce were inspected at produce inspection centres in the native areas. Inspection centres were improved as funds permitted, and it can now be said that very little produce leaves the native reserves without inspection. The inspection of squatter-grown produce is gradually being made complete.

The development of organized marketing has resulted in a considerable increase in native traders. In the Nyanza Province the Marketing of Native Produce Ordinance was introduced. In both the Nyanza Province and Central Province the Kenya Farmers' Association (Co-operative) Ltd., who buy at godowns leased from Local Native Councils, have had a beneficial effect in stabilizing maize prices. The Marketing Officer, while on leave in England, investigated markets for Kenya products in Great Britain.

Agricultural Statistics

The Agricultural Census, which is now taken biennially, was taken in February, 1938. This was the seventeenth census and dealt only with European areas. The results were published as a separate Agricultural Census Report early in 1939. The particulars given in the Census Report show that the period between February, 1936, and February, 1938, was one of consolidation and steady expansion. The total area occupied increased by ten per cent, the area under cultivation increased by nine per cent, and the area under crops increased by nine per cent also. The area under maize decreased by four per cent and the total area under coffee decreased by seven per cent. Increases were shown in the area under mature coffee (2 per cent), sisal (30 per cent), wheat (10 per cent), tea (6 per cent), sugar (34 per cent), pyrethrum (76 per cent), and fruit. The number of cattle increased by 15 per cent and the number of grade and pure-bred sheep increased by 16 per cent. The area of sown and planted permanent pasture increased by 66 per cent and the area under forage crops for stock feed increased by 15 per cent.

The monthly reporting of current agricultural conditions was continued in the Trade and Information Bulletins, and crop forecasts were issued from time to time in the same Bulletins.

Agricultural Exports in 1938

The total value of agricultural produce exported from Kenya in 1938 amounted to £3,045,507, as compared with £3,200,629 in 1937, a decrease of £155,122. In 1936 the value of these exports was £3,278,662.

The chief increases were:—

	£
Coffee	35,105
Beans	24,763
Maize	60,044
Potatoes	22,265
Pyrethrum	120,224
Sugar	22,657
Tea	34,227
Wattle Extract	8,472

The chief decreases were:—

	£
Hides	71,467
Skins	42,875
Cotton	87,403
Sisal	237,460
Groundnuts	26,018
Wattle Bark	16,127

The changes in quantity in the case of the more important products are given below:—

	Increase.	Decrease.
Butter (cwt.)	—	2,189
Hides	—	6,823
Skins (number)	—	440,277
Coffee (cwt.)	67,963	—
Cotton (centals)	—	14,991
Sisal (tons)	—	3,250
Beans (cwt.)	78,854	—
Maize (cwt.)	447,621	—
Maize Meal (cwt.)	25,868	—
Wheat Flour (cwt.)	—	11,254
Groundnuts (tons)	—	2,536
Potatoes (cwt.)	107,642	—
Pyrethrum (cwt.)	16,572	—
Sugar (cwt.)	37,537	—
Tea (cwt.)	2,381	—
Wattle Bark (cwt.)	—	112,802

QUANTITIES OF AGRICULTURAL COMMODITIES THE PRODUCE OF KENYA
EXPORTED DURING THE YEARS 1934 TO 1938 INCLUSIVE

COMMODITIES	Unit of Quantity	1934	1935	1936	1937	1938
ANIMALS, LIVING						
Cattle	No.	344	3,486	7,303	1,574	1,915
Sheep and Goats	"	4,094	5,491	8,897	11,133	14,720
ANIMAL PRODUCTS						
Bacon and Ham	Cwt.	757	989	1,168	1,132	1,309
Beeswax	"	1,807	1,184	808	1,323	1,494
Butter	"	11,330	16,287	24,983	22,898	20,709
Cheese	"	602	756	794	865	628
Ghee	"	2,927	4,552	3,965	2,296	2,140
Hides	"	100,651	80,684	52,462	56,341	49,518
Meat, Fresh and Preserved..	"	1,773	1,842	2,332	3,324	4,381
Skins (Sheep and Goats) ..	No.	979,585	1,190,351	1,794,060	1,806,565	1,366,288
Wool	Cntl	10,022	12,626	13,026	13,898	13,670
CROP PRODUCE						
Coco-nuts and Copra ..	ton	—	—	488	174	106
Coffee	Cwt.	187,017	359,883	409,262	273,887	341,850
Fibres—						
Cotton	Cntl	11,748	28,418	58,152	71,189	56,198
Sisal	ton	24,016	32,136	34,746	31,275	28,025
Fodder and Offals	"	1,674	4,764	4,746	2,675	2,829
Grains, Pulses and Meals—						
Beans	Cwt.	17,383	30,464	33,693	19,327	98,181
Maize	"	439,958	1,198,605	1,452,380	728,373	1,175,994
Maize Meal	"	90,895	106,743	137,761	99,423	125,291
Pulse (other than Beans) ..	"	3,239	3,025	6,318	8,388	10,673
Wheat	"	2,004	1,025	45,996	7,809	85
Wheat Flour	"	47,421	77,561	61,875	69,398	58,144
Miscellaneous	"	14,797	24,056	16,748	4,317	16,909
Oil Seeds—						
Cotton	ton	291	1,202	1,066	890	247
Groundnut	"	11	269	2,503	2,852	316
Linseed	"	168	—	—	19	55
Sesame	"	1,529	1,959	2,407	1,119	1,153
Sunflower	"	—	—	316	314	335
Oil—						
Coco-nut	Gallon	16,915	3,724	18,446	26,199	23,795
Essential	"	2,477	3,961	2,640	523	2,513
Groundnut	"	12,801	5,853	1,977	7,128	5,469
Sesame	"	18,068	94,486	81,756	105,451	88,632
Potatoes	Cwt.	40,445	96,675	103,347	71,995	179,637
Pyrethrum	"	—	—	20,798	19,413	35,985
Sugar (Raw and Crystallized)	"	73,364	86,055	131,904	92,821	130,358
Tea	"	22,115	45,108	67,099	81,835	84,216
Wattle Bark	"	258,177	223,138	240,914	201,655	88,853
Wattle Extract	"	49,734	101,888	110,272	123,632	120,055
Passion Fruit Juice	Gall.	—	—	—	—	17,004

VALUES OF AGRICULTURAL COMMODITIES THE PRODUCE OF KENYA
EXPORTED DURING THE YEARS 1934 TO 1938 INCLUSIVE

COMMODITIES	1934	1935	1936	1937	1938
ANIMALS, LIVING FOR FOOD					
Cattle	£ 579	£ 18,231	£ 50,898	£ 4,234	£ 5,610
Sheep and Goats	2,302	2,755	4,313	5,425	7,481
Miscellaneous	264	324	221	152	245
ANIMAL PRODUCE					
Bacon and Ham	5,022	6,369	7,247	7,646	8,637
Beeswax	7,046	4,933	4,044	7,188	6,462
Butter	41,266	59,652	96,564	93,916	86,460
Cheese	2,576	3,318	3,248	3,601	2,762
Ghee	7,951	11,638	11,367	9,820	9,620
Hides	168,550	143,538	123,480	196,071	124,604
Meat, Fresh and Preserved	5,983	7,472	9,112	11,437	18,092
Skins (Sheep and Goats)	26,089	35,849	67,137	104,281	61,406
Wool	30,037	41,710	44,174	52,633	51,305
CROP PRODUCE					
Coco-nuts and Copra	25	638	5,802	2,718	885
Coffee	493,343	934,923	969,804	732,684	767,789
Fibres—					
Cotton	28,483	76,326	149,789	191,518	104,115
Sisal	311,371	423,112	690,459	673,719	436,259
Fodder and Offals	3,787	16,034	16,474	12,000	11,674
Grains, Pulses and Meals—					
Beans	6,672	9,368	11,346	8,284	33,047
Maize	104,754	184,965	233,371	198,882	258,876
Maize Meal	25,755	20,002	20,716	29,186	30,336
Pulse (other than Beans)	1,534	1,635	2,011	3,294	3,689
Wheat	591	479	22,883	4,746	39
Wheat Flour	30,603	49,730	40,540	45,264	43,319
Miscellaneous	3,633	5,657	4,227	1,609	4,585
Oil Seeds—					
Cotton	694	3,210	2,867	3,357	546
Groundnuts	90	3,217	32,857	28,912	2,894
Linseed	1,504	—	—	1,117	2,573
Sesame	16,162	20,917	27,856	14,605	13,877
Sunflower	—	2,080	2,526	2,507	8,791
Oils—					
Coco-nut	1,007	354	1,983	3,255	1,683
Essential	6,799	7,823	7,687	2,337	5,561
Groundnut	1,116	727	277	993	570
Sesame	1,735	15,201	12,086	16,196	10,602
Potatoes	9,170	21,372	21,861	16,504	38,769
Pyrethrum	—	—	47,905	59,815	180,039
Sugar (Raw and Crystallized)	57,781	52,976	76,301	51,341	73,998
Tea	112,062	217,047	335,690	466,872	501,099
Wattle Bark	51,658	44,570	48,747	45,484	29,357
Wattle Extract	28,711	58,992	64,298	75,756	84,228
Passion Fruit Juice	—	—	—	—	3,400
Other Agricultural Produce	—	3,071	6,494	11,320	10,223
TOTAL .. £	1,596,705	2,510,215	3,278,662	3,200,629	3,045,507

Crops

Coffee

Exports of Kenya coffee in the period 1st July, 1937, to 30th June, 1938, amounted to 325,116 cwt., as compared with 348,672 cwt. in the previous period. The 1938 census showed that the area planted at February, 1938, was 93,772 acres, a decrease of 7,462 acres in comparison with 1936.

Production was 308,398 cwt. of clean coffee and 20,588 cwt. of dried cherry.

Rainfall was under average in most districts, but the shortage was serious only in some parts of the eastern area, where the long dry spell from the end of May to the beginning of October caused much of the crop to go light. In other parts, however, rainfall was quite well distributed and good crops were obtained. In the western districts crops were better than usual. The Nandi-Songhor crop was well above average, while in Kitale, though the acreage under coffee is becoming less, the yield remains about the same. As usual with a light crop, it ripened quickly, with the result that in many cases picking and pulping fell behind, and not a little of the crop was spoilt through careless preparation. In general, however, the year was a good one, with a continued improvement in quality, and in fact London prices were the highest for some time at the end of the year. They remained at a low level early in the year. This fall was occasioned as a consequence of events in Brazil, and occurred before the crop was on the market. From September onwards the price began to recover, and stood at 78/7 on the London market and at 50/8 on the Nairobi market in December.

A comparison with the 1936-37 season for Kenya coffee sales on the London market is given under:—

	1936-7		1937-8	
	No. of Bags of all Grades	Percent- age of Total	No. of Bags of all Grades	Percent- age of Total
Total Sold at over Sh. 50 per cwt. 	42,322	<i>Per cent</i> 98.5	26,245	<i>Per cent</i> 64.5
Total Sold at under Sh. 50 per cwt. 	639	1.5	14,420	35.5

The average London price for Kenya coffee was 58/-. On the Nairobi market the average price in the 1937-38 season was 35/6.

Monthly average prices realized at London auctions in the last five years were as under:—

Shillings per cwt.

MONTH	1934	1935	1936	1937	1938
January	60	80	64	79	59/7
February	74	84	66	77	61/6
March	79	73	65	66	56/5
April	70	66	55	65	55/3
May	65	54	49	62	53/5
June	52	38	48	59	46/11
July	57	36	45	61	58/9
August	52	37	53	56	55/2
September	64	38	60	62	58/6
October	40	47	67	61	64/6
November	54	52	67	58	69/8
December	57	47	67	56	76/7

(Figures for 1936 onward by courtesy of the Coffee Board of Kenya. Those before 1936 are as received by the Department from London).

Monthly average prices realized at Nairobi coffee auctions in the period 1936-37 are given below:—

	1937	1938
	<i>Sh. per Cwt.</i>	<i>Sh. per Cwt.</i>
January	43	34/11
February	42	33/11
March	40	33/2
April	38	29/-
May	39	26/-
June	41	26/3
July	40	30/2
August	43	40/3
September	44	44/3
October	44	46/7
November	43	51/5
December	34	50/8

(Figures by courtesy of the Coffee Board of Kenya.)

An analysis of export destinations is given below:—

	1934-5	1935-6	1936-7	1937-8
	<i>Cwt.</i>	<i>Cwt.</i>	<i>Cwt.</i>	<i>Cwt.</i>
United Kingdom ..	121,789	105,577	138,712	128,177
Other British ..	51,264	84,488	91,062	119,849
British Total ..	173,053	190,065	229,774	247,026
Foreign Total ..	66,417	219,884	118,898	78,090
World Total ..	239,470	409,949	348,672	325,116

It is interesting to note that the high export to foreign countries in the heavy crop year 1935-36 has not been maintained, but that exports to the countries of the British Empire, other than the United Kingdom, are increasing annually. On 1st January, 1938, the rail rate on coffee was reduced from 72/6 to 65/- (both less 10 per cent rebate).

For the reasons given in the 1937 Annual Report (Part I, p. 11), some coffee-growing districts are now sub-marginal under the market conditions of recent years. The problem of obtaining economic production in these districts is being attacked by the introduction of supplementary cash crops which, in time, may replace coffee.

Maize

In the season 1937-38, 113,103 acres of maize were harvested in European areas, yielding 968,076 bags of 200 lb. of grain. In the previous season the European-grown crops were estimated at 863,398 bags. Production in the season under review therefore shows an increase of 104,678 bags, or 12.12 per cent. The Kenya Farmers' Association pool, which does not include maize retained on farms nor maize grown by non-members, amounted to 751,813 bags, as compared with 666,235 bags in the 1936-37 pool. Exports (including other than European-grown) during the crop year July, 1937, to June, 1938, inclusive, are given below, in comparison with the previous season:—

	Maize	Maize Meal	Total
	<i>Cwt.</i>	<i>Cwt.</i>	<i>Cwt.</i>
1936-7.. ..	948,455	107,163	1,055,618
1937-8.. ..	1,175,994	125,291	1,301,285

In the crop season 1937-38 (i.e. to the end of June, 1938) the London price remained very steady, as in the previous season, at about Sh. 27 to Sh. 28 per quarter for K2. It touched a higher level than the previous season at Sh. 29, however, in April, 1938. In the latter half of the year prices were lower than in the corresponding period of 1937, falling to Sh. 24 at the beginning of December.

The 1937-38 European-grown crops were good, yields in Rongai, Solai and Njoro especially being considerably higher than in the previous season. Cold, wet conditions in some parts reduced the yield of later sowings. Army worm caterpillars did some damage in the early part of the season.

Growth of the 1938-39 European-grown crop was less satisfactory, owing to the late start of the rains and the subsequent wet and cold conditions. On 30th November, 1938, the acreage was estimated at 111,526 acres, the estimated production being 970,151 bags.

The native-grown crops were all good in the period under review. The 1937 short rains crops were good, except in the Kisii Highlands. The favourable internal price of maize at the beginning of the year induced the sowing of a large acreage in the long rains, especially in Nyanza Province. Shortage of rain in nearly all areas reduced crop prospects later in the season. Nevertheless, a good crop was harvested in many parts of the Nyanza Province. In the Kiambu District the yield was very poor, and consequently sales of maize outside the district were prohibited for a time. In the 1938 short rains a good acreage was sown in the Nyanza Province, but was later adversely affected by drought in some parts. The Central Province 1938 short rains crop promised well at the end of the year.

During 1938 there was a revival of the export of native-grown maize, a high internal price in the latter half of 1937 having stopped export.

The decline in the standard and quality of European-grown maize graded, reported in 1936 and 1937, was not overcome in 1938. There was a reduction in weevily and slightly weevily maize, but only 39.63 per cent was graded as K2. Wet maize rejected accounted for 6.58 per cent of the total (7.55 per cent in 1937).

STATEMENT OF EUROPEAN GROWN MAIZE PRESENTED DIRECT FOR GRADING (AT THE COAST AND KITALE)

YEAR	Total Recei- ved	GRADED		REJECTED				PERCENTAGE OF TOTAL		
		Slightly Weevily	Total	Weevily	Wet and Musty	Other Causes	Total	Slightly Weevily	Weevily	Wet and Musty
	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>			
1933	458,775	80,457	411,974	1,195	41,719	3,887	46,801	17.5	0.3	0.9
1934	205,826	30,347	197,324	4,325	1,686	2,491	8,502	14.8	2.1	0.8
1935	579,447	55,906	559,792	7,473	11,204	978	19,655	9.7	1.3	1.9
1936	837,098	157,073	680,056	64,859	73,186	18,997	57,042	18.8	7.7	8.7
1937	426,649	107,708	354,182	38,430	32,381	6,656	72,467	25.2	9.0	7.6
1938	492,317	72,303	435,009	17,808	33,361	6,139	57,308	14.68	3.6	6.8

The price of native-grown maize was lower than the high level reached in 1937. Early in the year the price stood at over Sh. 7, but later fell to between Sh. 6 and Sh. 7. The Kenya Farmers Association (Co-operative) Ltd. pay-out for the 1937-38 season was Sh. 7/20 per bag.

The Maize Inspection (European Areas) (Amendment) Rules, 1938, were brought into force, and provide for the control of the sale of maize grown by natives in European areas.

Wheat

The yield of wheat in the 1937-38 season was estimated at 234,016 bags, as compared with 222,000 bags in the preceding season. The 1937-38 wheat pool totalled 180,446 bags. The pool pay-out ranged from Sh. 18/37 per bag for Grade 1 wheat to Sh. 10/37 for Grade 12-14, being rather higher than in the previous season.

There was a steady decline in wheat prices in 1938, at the beginning of the year the London price for Kenya wheat being about 38/- per quarter (average) and at the end of the year 21/6d. for Equator and 22/- for Governor.

Wheat sold to mills in the period October, 1937, to September, 1938, amounted to approximately 127,670 bags, at an average price of Sh. 18/44 per bag; this price included rebate sales. In the previous corresponding period sales totalled 179,522 bags, at an average price of Sh. 18/40 per bag.

Production in Kenya of millable wheat again fell short of the local demand. Accordingly, Government again approved the importation by the agents, under the Sale of Wheat Ordinance, of wheat up to a specified maximum quantity. 1,450 tons were imported. The same conditions to govern that importation were imposed as for the previous year.

The total production for the 1938-39 season was estimated at 257,813 bags.

Sisal

At the end of December, 1937, the price of East African No. 1 sisal fibre on the overseas market stood at £20 per ton, a decline in price having started in September of that year. In January, 1938, the price fell to £16-12-6, and ranged between this figure and £18-15-0 throughout the year.

Another fall in the quantity of sisal fibre exported occurred. The exports for the years 1936-38 were:—

1936	...	...	...	...	34,746 tons
1937	...	...	...	...	29,008 tons
1938	...	...	...	...	26,145 tons

The corresponding declared values at port were:—

1936	...	...	...	...	£690,459
1937	...	...	...	...	£637,153
1938	...	...	...	...	£414,789

In comparison with 1936, there was a drop of 39.9 per cent in the declared value, occasioned by reduced price and reduced quantity exported.

Tea

Exports of tea amounted to 84,216 cwt. (9,432,192 lb.) in the calendar year 1938, as compared with 81,835 cwt. (9,165,520 lb.) in 1937, corresponding values being £501,099 and £466,872 respectively. Figures of manufactured tea received into stock-room are as under:—

Year ending 31st December, 1937 ... 10,809,046 lb.

Year ending 31st December, 1938 ... 10,856,085 lb.

The Tea Cess Ordinance continued in operation during 1938.

Under the International Tea Restrictions Scheme extra acreages were allotted in 1938 in established tea areas and permission was given for the planting of tea up to a prescribed maximum acreage in new areas, viz. Kaimosi, Nandi, and Sotik. According to a five-year plan, planters must complete the planting of the new acreages allotted to them by the year 1943.

In comparison with the 1936 level, the average price of Kenya tea on the London market increased up to August, 1937, when it stood at 14d. From then it declined, being 13d. at the end of 1937. Up to May, 1938, it was slightly higher than 13d., the highest price touched being 13.60d. in January, 1938. From May onwards it declined again, touching 11.57d. in November, but there was a slight recovery to 11.88d. in December, 1938, and to 12.11d. in January, 1939.

Sugar

In February, 1938, the area under cane had increased to 15,544 acres, the area in February, 1936, being 11,568 acres. The production of crystallized (refined) sugar in the period 1st March, 1938, to 28th February, 1939, was 264,502 cwt., as compared with 317,720 cwt. in the preceding period. The production of raw sugar in the same period was 33,920 cwt., the total production of both raw and refined sugar thus being 298,422 cwt.

Exports of refined sugar increased from 74,136 cwt. valued at £43,901 in the calendar year 1937 to 109,372 cwt. valued at £64,764 in the calendar year 1938. Raw sugar exports in 1938 amounted to 20,986 cwt., the total of 1938 exports thus being 130,358 cwt., valued at £73,998, as compared with 92,821 cwt. in 1937, valued at £51,341.

It is probable that local consumption in Kenya increased again in 1938; it certainly did not fall. Exact figures for Kenya consumption alone are difficult to obtain because, in addition to the consumption of Kenya produced sugar, Uganda produced sugar is consumed in Kenya. Kenya and Uganda consumption figures together rose from 523,000 cwt. in the period September, 1936, to August, 1937, to 712,790 cwt. in the period September, 1937, to August, 1938, the first quota year under the International Sugar Restriction Scheme.

This scheme, which came into force on 1st September, 1937, remained in force throughout 1938, the export quota originally allotted to East Africa, viz. 27,000 tons, being unchanged. When the scheme first came into force an order was issued under the Customs Management Ordinance prohibiting the export of raw or crystallized sugar to places outside the three territories (i.e. Kenya, Uganda and Tanganyika) except under permit from the Director of Agriculture. On 13th September, 1938, the Sugar (Control) Ordinance, 1938, came into force. This Ordinance provides for the control of the quantity of sugar which may be exported in any quota year ("the quota") from Kenya and provides for the allocation of the quota among sugar manufacturers.

The price of sugar was 6/- per cwt. in January and 5/6d. per cwt. in December, the minimum reached in 1938 being 4/11½d.

Wattle Bark and Extract

At the end of 1937 the overseas price of Kenya chopped bark stood at £8-12-6 per ton c.i.f. Throughout 1938 that price remained unchanged. The price of East African wattle extract was reduced from £19 to £17-10-0 per ton in December, 1937. In February, 1938, it rose to £18 and remained at this figure until December, 1938, in which month it fell again to £17-10-0.

Exports of bark were only 89,853 cwt. in 1938, as compared with 201,655 cwt. in 1937. The corresponding declared values were £29,673 and £45,484 respectively. This reduction was caused by increase in the output of wattle extract, but a corresponding increase in export of wattle extract

in 1938 did not materialize because of the decline in demand in a number of overseas markets. Exports of extract in 1938 amounted to 119,055 cwt., as compared with 123,632 cwt. in 1937. The corresponding declared values were £75,756 and £83,916 respectively (in the first half of 1937 the price of extract was only £16 per ton).

The price of dry bark at Thika was Sh. 64/96 per ton at the end of January. After the long rains "close season" in July it remained the same. The price for green bark was Sh. 37/50 per ton. At the end of August these prices had risen to Sh. 72/80 and Sh. 41/25 respectively, and they remained at that level throughout the remainder of the buying season.

The quality of native-produced bark in the Fort Hall District showed a marked improvement in 1938. In the Kiambu Native Reserve bark was cut prematurely to provide wood for charcoal burning for the Nairobi market, and consequently cutting has been prohibited in the period 14th February, 1939, to 31st December, 1939.

Pyrethrum

Unlike 1937, this year was favourable for this crop, but at times the pyrethrin content dropped below the standard 1.3 percentage. The causes of this are discussed in Part II. The figures of production and value for this crop in the last three years are given below:—

					Production	Value
					<i>Cwt.</i>	£
1936	..	..	..	..	20,798	47,905
1937	..	..	..	..	19,413	59,815
1938	..	..	..	..	35,985	180,039

The price, which rose to £95 in 1937, did not fall below this in 1938. Growers fear a substantial fall in price, but this is not likely for some time yet if the pyrethrin content is maintained. The high price is encouraging a largely increased acreage under the crop.

The price for Kenya pyrethrum in 1938 was at its lowest in January at £100 and at its highest in June at £140. In December it was £118. The price of Japanese pyrethrum averaged £83-16-0 in 1938.

The Pyrethrum Board under the 1935 Ordinance continued to act in an advisory capacity, with the Kenya Farmers' Association (Co-operative) Ltd. as agents. The pool pay-out in the year ending 31st March, 1938, was 61 cents per lb. for first grade.

Later in the year the lower grade prices were reduced, in order to encourage more careful production.

Towards the end of the year the Pyrethrum Ordinance, 1938, became law. Under this Ordinance a statutory board was provided for.

Passion Fruit

This industry continued its development in 1938. The number of growers registered with the Board at the end of the year was 91, and the area stated by them to be under passion fruit was 1,126 acres.

In all, four factories were in operation producing for the pool, viz. at Sotik, Hoey's Bridge, Lugari, and Kitale. The February, 1938, census gives 982 acres as the area under passion fruit for the census year March, 1937, to February, 1938. Passion fruit juice exports in the calendar year 1938 amounted to 17,004 gallons, valued at £3,400. This was a considerable increase over 1937. Since the end of the year it has become apparent that the production, largely increased recently, now exceeds the overseas demand at present prices, and marketing policy is to be reviewed.

Cotton

The yield of the 1937-38 crops showed a decrease of 20,910 bales in comparison with the previous crop. This was due to less favourable weather conditions than in the preceding season and to the disappointment of growers (almost entirely native) at the fall in price which occurred in August, 1937. In 1938, the price of cotton remained at a low level, viz. 4.79d. per lb. average Liverpool four-month American middling futures. Growers' disappointment consequently increased, and in nearly all areas the acreage sown in the 1938-39 season was less than in the preceding season. On top of this came weather conditions very unfavourable for cotton in all three cotton-growing Provinces. Hot, dry weather caused premature flower and boll shedding everywhere, but especially in the Coast Province. In the Nyanza and Central Provinces also the crop was much reduced. The yield in the 1937-38 season was 22,910 bales; in the 1938-39 season it was 9,976 (approximate) bales.

Production in Kenya in bales of lint in the last nine seasons is given in the table below:—

YEAR	NYANZA PROVINCE	COAST PROVINCE	CENTRAL PROVINCE	TOTAL PRODUCTION
	† <i>Bales</i>	<i>Bales</i>	<i>Bales</i>	<i>Bales</i>
*1930-1 ..	740	43	—	783
1931-2 ..	1,257	487	—	1,744
1932-3 ..	3,219	1,057	—	4,276
1933-4 ..	5,690	1,059	—	6,749
1934-5 ..	7,206	1,567	—	8,773
1935-6 ..	11,830	3,730	223	15,783
1936-7 ..	17,840	2,840	1,486	22,166
1937-8 ..	16,801	1,790	1,019	19,610
1938-9 ..	8,619	549	818	†9,976

*The first year shown is the year of sowing; harvesting and ginning extends into the following year. †Bales of 400 lb. lint. ‡Approx.

The Kenya Fruit Growers' Association

Another attempt was made to provide special marketing facilities for the fruit crops of members of this Association. The scheme was for the 1938-39 crop. Unfortunately, it had to be dropped on account of lack of co-operation among members. Until greater unanimity is shown by Kenya fruit-growers, little can be done to improve marketing facilities for locally grown fruit.

The Kenya Fruit Growers' Association, which still nominally exists, has ceased to be an active organization.

Animals and Animal Produce

The year was less favourable than 1937 for stockowners, rainfall being more erratic and in some parts inadequate. The condition of pastures was adversely affected by the hot, dry weather. Up to July, grazing in most parts of the country was in a satisfactory condition, sufficient rain having fallen. In August, dry weather began to affect grazing in most parts of the country except the Lake area. In September rain helped grazing except in the Nairobi and Masai areas. Rain failed again in October, grazing becoming very sparse, especially in the northern areas. In December grazing improved in many areas, but in others locusts caused it to deteriorate even more.

The formation of a Meat Control Board, advocated by the Meat and Live Stock Committee, which reported in 1937, was under consideration again during the year. Messrs. Liebig's factory for the manufacture of meat products from low-grade cattle, chiefly of native origin, was opened early in 1938, and operated throughout the year, except for one period of three months, when it was closed on account of insufficient supply of cattle.

The scheme for the control of overstocking in native reserves under the Crop Production and Live Stock Rules, 1937, begun in 1937, was continued. Public auctions of cattle, voluntarily or compulsorily culled, were held on several occasions. In September a certain section of the Kamba tribe protested against the destocking scheme. Later, the destocking measures were temporarily discontinued.

Another recommendation of the Meat and Live Stock Committee was that export outlets for chilled beef, meat products, frozen lamb and frozen pork should be explored. In pursuance of this recommendation, a trial consignment of frozen pork was sent to the London market under the ægis of the Kenya Co-operative Creamery Limited. This trial consignment was successful, the price realized at Smithfield being 7d. per lb., in comparison with 7½d. per lb. for first quality New Zealand pork. An instructive report on certain minor faults in the shipment has been received, and these faults will be remedied in future shipments. Several shipments were also made of green bacon in 1938.

Butter

The production of butter in the last four years is given under:—

YEAR	Creamery Produce	Private Produce	Total Production
	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>
1935.. .. .	2,278,858	276,492	2,555,350
1936.. .. .	3,118,303	294,601	3,412,904
1937.. .. .	2,131,783	235,242	3,367,025
1938.. .. .	2,874,356	164,055	3,038,411

The Butter Levy Ordinance continued to be in operation in 1938. The quantity of butter sold locally and the assistance provided by local sales to exports were as under:—

YEAR	Quantity of Butter on which Levy was Received	Subsidy on Butter Exported
	<i>lb.</i>	<i>Cts. per lb.</i>
1933	606,285	20·555
1934	662,913	15·319
1935	586,920	8·386
1936	585,067	5·250
1937	675,566	7·250
1938	647,890	7·783

The export of butter decreased from 22,898 cwt. in 1937, valued at £93,916, to 20,449 cwt. in 1938, valued at £84,133.

The South Kinangop Creamery ceased to operate after the month of June, 1938.

In 1937 the price of butter rose steadily, standing at Sh. 113 per cwt. in London (for New Zealand first quality), as compared with Sh. 105 a year earlier. In January, 1938, the price fell again to Sh. 105, but recovered in February to Sh. 113. It rose to Sh. 128 per cwt. in April, and from then until October fell gradually to Sh. 112. In November it fell to Sh. 101, but recovered to Sh. 110 in December. The monthly pay-out in 1938 by the Kenya Co-operative Creamery did not touch the level of the December, 1937, pay-out (1/02), but ranged between 90 and 98 cents, falling once (in October) to 83 cents.

Butter Ghee

Kisumu and Machakos ghee prices in Nairobi ranged between Sh. 24 and Sh. 37 per frasila in the case of the former and between Sh. 23 and Sh. 38 in the case of the latter.

Hides

The quantity of hides (shade- and sun-dried) exported in the last four years is shown below, together with corresponding values and percentages:—

Year	Shade-dried		Sun-dried		Total	Shade-dried	Sun-dried	Total
	<i>Cwt.</i>	<i>Per cent</i>	<i>Cwt.</i>	<i>Per cent</i>	<i>Cwt.</i>	£	£	£
1935	26,344	33	54,340	67	80,684	57,427	86,111	143,538
1936	24,145	46	28,317	54	52,462	65,536	57,944	123,480
1937	27,028	48	29,313	52	56,341	109,357	86,712	196,069
1938	26,394	53	23,127	47	49,521	72,905	49,697	122,602

In this four-year period the percentage of shade-dried hides has steadily risen and that of sun-dried hides has correspondingly fallen, until for the first time more shade-dried than sun-dried hides were exported. There was a decrease in the total exports in 1938 in comparison with 1937. This is probably partly due to the lower level of prices on the overseas market. The London price for heavy weights was above 9d. per lb. for the whole of 1937 up to October, when a decline set in. From March to May, 1937, the price was above 10d. From October, 1937, the price fell and remained below 8d. per lb. throughout 1938, the lowest price touched being 5½d. in December, 1938. The major fall in exports was in sun-dried descriptions.

The peak of 1937 Nairobi prices was in April, when shade-dried firsts fetched Sh. 36/55 per frasila and sun-dried fourths fetched Sh. 21/11 per frasila. In comparison, 1938 local prices were much lower. Shade-dried firsts started at Sh. 23/59 per frasila in January, the highest price of the year, with sun-dried fourths at Sh. 10/73. The price had fallen to below Sh. 19 for shade-dried firsts in May and only once again touched a higher level than Sh. 19 before the end of the year, i.e. Sh. 19/90 in October. The price of sun-dried fourths varied accordingly. The lowest prices were in September, viz. Sh. 18/07 and Sh. 6/31 respectively.

Skins

Total exports of sheep and goat skins for the last four years are given below:—

YEAR	Cwt.	£
1935	1,190,251	35,849
1936	1,794,060	67,137
1937	1,806,565	104,281
1938	1,366,288	61,406

A sub-classification of skins was made for the first time in export declarations in 1937. Analysis of exports for the last two years is given under:—

DESCRIPTION	1937		1938	
	Number	Value	Number	Value
		£		£
Sheep Skins (sun-dried) ..	153,965	4,157	30,723	769
Sheep Skins (shade-dried) ..	93,566	4,553	56,152	3,081
Goat Skins (sun-dried) ..	1,408,361	86,625	980,579	43,327
Goat Skins (shade-dried) ..	150,673	8,946	298,834	14,229

It will be noted that there is an increase in the exports of shade-dried skins and a decrease in the exports of sun-dried skins, both sheep and goat.

The price of shade-dried first grade goat skins at Nairobi was Sh. 29/60 in January and Sh. 29/90 in February, per score. The price then fell to Sh. 22/80 until July. It then rose to Sh. 23 in the period August–October and to Sh. 28/25 in November and December. In the period April–October, inclusive, there was no differentiation in price between shade-dried and sun-dried descriptions.

Wool

Exports of wool in 1938 amounted to 13,670 centals, valued at £51,305, as compared with 13,898 centals in 1937, valued at £52,633. The Board of Trade index of raw wool prices was at 177 in January, but then fell to 105 and remained between 105 and 110 until the end of the year. In September, 1937, it was at 155.

Royal Horticultural and Agricultural Society of Kenya

The Society held a limited show at the Nairobi Show-ground in January. This show was confined to coffee, poultry, pigeons, dogs, and gymkhana events.

The Society also held a full show at Nakuru in June.

Both these shows were thoroughly successful. Exhibits were staged by this Department among others.

In 1938 a maize seed competition was again held in collaboration with this Department. The milk-recording scheme progressed satisfactorily.

In collaboration with the Society, this Department and the Veterinary Department gave broadcast talks to farmers every fortnight throughout the year. These talks were reported in the Press. Subjects discussed included:—

Mixed Live Stock Policy.

Wheat: What to plant in 1938.

Progress in Coffee Research during 1938.

Chemistry and Agriculture.

The Problem of Plant Quarantine.

Control of Mealy Bug.

Progress of Experiments on the Technique of Vegetative Reproduction.

Results of Investigations into Elgon Dieback.

Messrs. Cable and Wireless Ltd. are thanked for their co-operation.

Shows

Apart from the two shows mentioned in the paragraph on the Royal Agricultural and Horticultural Society of Kenya, two one-day shows were held by the Department in native areas, one at Mumias, North Kavirondo, in February, and the other at Kibarani, Kilifi District, in August, at the latter of which His Excellency the Governor was present. Both of these shows were well supported.

Fertilizers

The possibility of introducing legislation to regulate the sale of fertilizers was under consideration in 1938. It is probable that such legislation will be promulgated in 1939.

Board of Agriculture

The Board ceased to exist at the end of September. The main reason for this is that nearly all agricultural interests now have their own representative bodies, thus causing the Board to become largely redundant. When the Board was first established there was little representation of agricultural interests other than through it.

The 1938 Locust Invasion of Kenya

The following is taken from the report of the Senior Entomologist:—

Nomadacris septemfasciata (Red Locust)

Two medium-sized swarms, six miles by three, of the red locust entered North Kavirondo from Tororo, Uganda, on the 15th and 19th of May respectively. These swarms split into smaller ones, which engaged in circular flights, visiting various areas in North and Central Kavirondo, the Trans Nzoia, the Kibigori-Muhoroni Valley, and the Nandi country. During their sojourn within the Colony very light damage to crops took place and no laying occurred. By the first week in July the small swarms had either returned to Uganda or had been destroyed by diseases and pests, and the Colony became for a time entirely free of locusts.

Locusta migratoria migratorioides (Migratory Locust)

In a letter dated the 21st July from Sir Guy Marshall, Director of the Imperial Institute of Entomology, it was stated that if the summer rains in the Sudan were favourable for breeding there was a danger of the appearance of swarms of the migratory locust in North Kenya after September–October. No sooner was this letter received than telegraphic information showed that huge swarms were entering Northern Turkana from the north-west in the Sudan. Between the 27th July and the 23rd August several large swarms entered the Colony direct from the Sudan on our north-western boundaries. Invasion thus took place at least one generation earlier than was anticipated. These swarms proceeded either in a south-easterly direction until they arrived in the Mukogodo-Isiolo area or proceeded south into the Kerio Valley or slightly west of south until they arrived in the vicinity of Mount Elgon. Their subsequent movements within the Colony were then determined by local topography, and the locusts kept generally to the various valleys encountered. Migration thus continued through the dry desert areas of the Northern Frontier Province until the locusts arrived in areas where food supplies

were plentiful. So far as is known, only one swarm, ten miles long by one mile wide, entered the territory through Uganda, probably through Karamoja and around the western slopes of Mount Elgon.

Mukogodo-Isiolo Area.—Flying swarms arrived in this area between the 4th and 12th of August. They remained within the area for about one month, feeding and circling around, during which time they visited Meru, Timau and Nanyuki. Little damage to crops took place, though several fields of wheat were destroyed. From the beginning of September to the middle of the month migration commenced, first to the east through Meru, and then to the south, until the whole of the above area became free of locusts. The swarms passed on through Embu, Fort Hall, Thika, Ruiru, Nairobi, and into the Rift Valley. On entering the Rift Valley the majority continued their southerly migration into Tanganyika and none of these swarms laid within the Colony.

Mount Elgon.—The first swarm arrived on the eastern slopes of Mount Elgon on the 26th August, and further swarms continued to arrive until the 19th September. These spread into North Kavirondo and all over the Trans Nzoia and Uasin Gishu Plateau.

Kerio Valley.—Swarms from the Kerio Valley overflowed into the Baringo Valley and the Kamasia Reserve and spread into the districts of Ravine, Rongai, Subukia, Solai, Njoro, Nakuru, and further south to Lake Naivasha, from the 5th August to the end of October.

Egg-laying took place over wide areas within the Colony, and hopper infestation was severe in certain districts. The heaviest infestation occurred in the Trans Nzoia and Uasin Gishu districts, and the infestation in this area was more severe than that of the 1931 infestation.

Owing to differences in climatic conditions in the several areas invaded, laying commenced at different times. In the Nyanza and Nzoia Provinces laying commenced at the beginning of October, whereas in the Nakuru Province laying did not occur until the first week in November.

As a result of observations made in the field, evidence has been obtained which clearly indicates that the various swarms laid at least four times, and most probably five and six times, at intervals of eight to twelve days. This resulted in very large areas being laid over by each individual swarm and progressive hatching over a period of some two months.

Owing to the relatively short incubation period in this Colony, fourteen days and upwards according to elevation, there is not sufficient time to prepare adequately for a large campaign once laying has commenced. Preparation for such a campaign should commence as soon as the flying locusts have ceased migration and commenced their circular flights within a particular area and when regular dissection of locusts reveals that ovarian development is rapidly taking place. This increases the time for preparation by at least three weeks, even under the most favourable climatic conditions. It cannot be too strongly emphasized that the first essential for a successful anti-locust campaign is to be fully prepared with material and an efficient organization before hoppers commence to hatch.

During the present invasion Government was advised to commence preparations for a hopper destruction campaign on the 6th September. Egg-laying first commenced on the 1st of October, and the first hatching took place on the 22nd October. This period of slightly more than six weeks enabled Government to be fully prepared with adequate supplies of bait and spray material, to put into operation an efficient organization and to deliver supplies to the areas concerned by the time hoppers emerged. This preparedness and the efficient anti-locust organization resulted in the campaign being a complete success, and relatively few hoppers escaped destruction. It can be proved that over 99 per cent of eggs and hoppers were destroyed at a much lower relative cost than in any previous campaign undertaken in the Colony.

(The actual cost of the campaign is given after the Senior Entomologist's report.)

The results obtained with poison bait have demonstrated beyond doubt that baiting is by far the most efficient and economic method yet known of destroying locust hoppers in Kenya, and that, when properly distributed, it constitutes no danger to stock. Owing to the low state of intellect of certain native tribes, it is not always possible in practice, even under adequate supervision, to distribute poison bait properly, and loss of stock may result. A single case of stock poisoning occurring soon becomes known, and has a tremendous psychological influence on stock farmers, which increases the difficulties of a locust officer out of all proportion to the loss incurred. This difficulty has been met to a certain extent by Government promising to pay compensation for loss where it can be shown that all reasonable steps have been taken to distribute poison bait as recommended. It is probable that the

fear of and loss from poisoning as a result of baiting may be eliminated entirely if a simple method can be devised to eliminate certain lumps from the bait before distribution.

In the present campaign preparation and mixing of bait according to a standard formula supplied by Government was undertaken by a commercial firm at a central factory, and bait was delivered free on rail at a cost of Sh. 6 per ton; the arsenic was supplied by Government. This arrangement has proved eminently satisfactory, and the firm is to be complimented upon the excellent manner in which it has carried out the work at so reasonable a charge.

During the campaign, 5,880,000 lb. of bait were mixed, of which 4,524,800 lb. were issued. Of this quantity, 3,734,000 lb. were used in the Nzoia Province. Before the campaign commenced Government was informed that a minimum of 1,900 tons of bait would be required, and it is interesting to note that 2,019 tons were actually issued.

Statistical Information

300,000 acres were laid over. Maize, wheat, oats, barley and millet were destroyed or damaged. The percentage of loss was too variable to estimate, but the approximate total monetary value of losses was £35,000. The losses of live stock due to accidental poisoning by bait amounted to 81 head, valued at £300; no losses of live stock from other causes occurred. Famine relief measures were not necessitated.

The analysis of the total cost of the campaign is as follows:—

	£
Miscellaneous	127
Salaries: Europeans	872
Labour and <i>Posho</i>	389
Car and Subsistence	914
Transport	2,694
Bait and Spraying Materials	4,031
Spraying Equipment	204
Camp Equipment	591
Total ..	<u>£9,822</u>

Vegetation Map

A vegetation map of Kenya was produced by Mr. D. C. Edwards, the Agricultural Officer in charge of Pasture Research. A very wide range of climate exists in Kenya. To the north and east the greater part of the country is arid and hot, and towards the west moist, tropical conditions occur. The central highland area, occupying about one-third of the country, has a climate which is sub-tropical except for the short duration of its equatorial days. The soils of Kenya are

also extremely variable. Grassland covers, in one form or another, nearly the whole country, except the forest portions of the higher mountain masses. The main types of vegetation are forest, mountain grassland, parkland or savanna, and semi-arid grassland.

Plant and Seed Exchange

Plants and Seeds issued to Overseas Countries during 1938

Hong Kong.—Rhodes grass (three strains), Kikuyu grass (three strains).

Nyasaland.—Rhodes grass (three strains), Giant *Cynodon*, *Amphilophis pertusa*, *Cenchrus ciliaris* (two strains), two species of local *Digitaria*, six varieties of Kenya-bred wheat, Durum maize.

Palestine.—Eleven species and strains of Kenya grasses.

Hawaii.—Seven species and strains of Kenya grasses, *Trifolium Johnstonii*.

Nigeria.—Five species and strains of Kenya grasses.

Philippine Islands.—Three strains of Rhodes grass.

Australia.—Thirteen species and strains of Kenya grasses, *Indigofera tettensis*.

South Africa.—Three strains of Kikuyu grass; Kenya-bred wheats.

Tanganyika.—Three strains of Kikuyu grass; Muratha maize; *Commiphora* sp.; Durum maize; Madagascar butter beans; Rose Coco beans; Lima beans; Soya beans; Canadian Wonder beans; Dwarf Hegari sorghum; Peshawari and Basmati rice; high nicotine content tobacco.

Gold Coast.—Four species and strains of Kenya grasses.

Abyssinia.—Four species and strains of Kenya grasses; *Trifolium Johnstonii*.

United States of America.—Three species of Kikuyu grass; two *Cynodon* species; Kenya-bred wheats; ten sweet potato varieties.

New Zealand.—*Cynodon plectostachyum*; *Trifolium Johnstonii*; *Indigofera tettensis*; *Themeda triandra*; passion fruit; wheat No. 58.

Cyprus.—Four species and strains of Kenya grasses.

India.—Muratha maize; Cape tomato; Kenya flat white maize; gram.

British Somaliland.—Bengal gram, black gram, green gram; Muratha maize; awned bulrush millet; sorghums; Kitui pigeon pea; Malindi cascara; groundnuts; peas.

New Guinea.—Six varieties of coffee seed; oyster nut.

New South Wales.—Soya beans; Victoria peas; Boston beans; bulrush millet, foxtail millet; Dobbs sorghum, Kano sorghum; Bukura eleusine; senna rice; three species of *Crotalaria*; Dutch marrowfat peas; three varieties of beans, *Gerbera* varieties; several strains of Kenya-bred wheats.

Eritrea.—Wheat seed of several Kenya-bred strains; Lampton oats, Biffen oats; Chevalier barley; Muratha maize; Kano and Dobbs sorghum; Bukura eleusine; Lespedeza; Rhodes grass, Napier grass; edible canna.

Canada.—Durum maize; Kano and Dobbs sorghum; several Kenya wheats.

Barbados.—*Dolichos* bean varieties.

Southern Rhodesia.—Six varieties of rice; *Dolichos* bean; Lampton oats, Biffen oats; Prior barley.

Costa Rica.—Three varieties of Kenya-bred wheats.

Sudan.—*Ocimum kilimandsharicum*.

Jamaica.—Durum maize, Muratha maize, flat white maize; Tepary, Madagascar butter and Rose Coco beans; Morogoro and Embu cowpeas; Bengal gram; *Dolichos* beans; black Mauritius bean.

*Plants and Seeds received from Overseas Countries
during 1938*

Hawaii.—Seven species of grasses.

Puerto Rico.—*Pennisetum occidentales*.

Australia.—Seven strains of *Trifolium subterraneum*; blue lupin.

South America.—Bracatinga.

Uganda.—*Cassia* sp.; wild Robusta coffee.

Congo Belge.—*Crotalaria agatiflora*; *Sesbania* sp.; four varieties of lupins; *Indigofera arrecta*; Pigmy coffee variety; San Ramon *miniatura*.

India.—Bhimli jute.

Federated Malay States.—Oil palm.

Tanganyika.—Sweet lupin.

Nigeria.—Oil palm; groundnuts (three strains).

United States of America.—*Astragalus rubyi*.

Germany.—Serradella.

Canada.—Three varieties of Soya beans; fourteen varieties of tomatoes.

Argentine.—Nine varieties of wheats.

Java.—Two varieties of guava.

Barbados.—Five varieties of sweet potatoes.

PART II—WORK OF THE DEPARTMENT OF AGRICULTURE

European Areas

EXTENSION WORK

The entomological, plant pathological, plant breeding, chemical and coffee sections of the Department provide research and advisory services for the European areas, and the agricultural officers stationed at Njoro and Kitale give local advisory services and conduct investigational work in connexion with the European agriculture of their areas. The work of the two agricultural officers is dealt with fully in this part of the report, in which also the main items of the work of the above-mentioned specialist sections is summarized under specific headings. The full report of the work of these specialist sections will be published as Volume II of this report.

As far as is possible, the investigational work which is being carried out is made available to farmers in the Press and the *East African Agricultural Journal*. In addition, every opportunity is taken of putting members of the Department into personal touch with farmers in order that full explanations and demonstrations of the work being done may be given. Specialists and other officers made several tours in many of the agricultural areas in 1938, and gave lectures to farmers' associations and other meetings, besides visiting a number of farms.

The Senior Plant Breeder and Experimentalist remained in charge of the Coffee Team Services and also acted as Deputy Director of Agriculture during the latter half of the year. Officers in charge of special branches of the research work in the Coffee Team Services in 1938 included:—

Dr. Le Pelley, Mr. Melville: Mealy bug, Parasites.

Mr. Gethin Jones, Soil and liquoring problems.

Mr. Gillett, Cultural problems.

Mr. C. A. Thorold, Elgon die-back and related problems.

Mr. D. C. Edwards, Agricultural Officer, remained in charge of pasture research, Mr. Wilkinson of the entomological section and Mr. Beckley of the chemical section. Dr. Nattrass became Senior Plant Pathologist on 1st September, Mr. Thorold having acted in that post from the time of Mr. McDonald's departure in 1937 until then.

Turning to soil conservation, it can be recorded that some progress was made by farmers in the terracing of their land, but the application of control measures in the widest sense, that is, including better farming, must be speeded up if the march of erosion is to be countered.

At the beginning of 1938 a special Soil Conservation Service was instituted within the Department of Agriculture. In the words of His Excellency the Governor in a speech in Legislative Council, this Service was to "have the responsibility of carrying out advisory work and propaganda in both European and native areas, of preparing construction schemes and assisting in their execution".

The Soil Conservation Service was begun with a staff of a Soil Engineer, Mr. R. O. Barnes, and an Agricultural Officer in Charge, Mr. Colin Maher.

The Soil Engineer was placed in technical control of soil conservation work at Machakos, including the special area at Matungulu for which a free grant of £10,000 was provided by the Colonial Development Fund to permit of a comprehensive scheme of soil conservation including both demonstration and experimental work.

Steady progress was made by the Soil Engineer and the four area supervisors under his direction and the confidence and co-operation of the natives was attained to a remarkable degree.

INVESTIGATIONAL WORK

Investigational work for European areas is carried out at the Scott Agricultural Laboratories, the Plant Breeding and Experiment Station at Njoro, the various coffee sub-stations, the new high level Sisal Research Station at Thika, the Agricultural Station at Kitale, the Veterinary Research Laboratories at Kabete (for pasture research) and on a number of private farms in co-operation with the owners.

PLANT INTRODUCTION

In pursuance of this Department's policy of trying promising types of crops from other countries, as part of its work of improving the types grown in Kenya, fifty introductions were made in 1938. Of these thirty-four were issued to this Department's stations in European areas and, in some cases, direct to a few selected farmers, for trial.

The introductions under trial in European areas include various leguminous green manure and cover crops, three types of Seradella (a fodder crop), Soya beans, various strains of

tomato from Winnipeg, Canada, wheats, *Bromelia Magdalenae* (a fibre plant) and jute. Owing to the necessity in most cases for continued trial before definite results can be obtained, it is not yet possible to publish the final results of these trials. It may be said, however, that *Lathyrus splendens*, a green manure and soil binder, is promising as a soil binder in erosion control work; that an indigenous *Dolichos* species, and an indigenous *Tephrosia* species, both obtained from Songhor, show some promise as cover crops; and that *Bromelia Magdalenae* died out. Countries from which these fifty introductions came include the United Kingdom (Kew), Tanganyika Territory, India, the Federated Malay States, Nigeria, the United States of America, Australia, Puerto Rico, Canada, and the Argentine.

COFFEE

Investigational work on cultural, pest, soil and liquoring problems of coffee is centralized as much as possible at the Scott Agricultural Laboratories, and this station also specially serves the eastern coffee areas and more especially the Kiambu District. There is also a sub-station at Thika with its own sub-station at Makuyu. The special cultural problems of the western area are studied at the Kitale and Nandi stations, whilst at Kapretwa Estate, Mt. Elgon, a special investigation is being made into Elgon die-back and allied physiological manifestations. The Nandi station deals largely with coffee berry diseases and has a sub-station at Sotik for the purpose; work is also conducted from that station on leaf disease.

In addition to work at these stations, there are a number of co-operative experiments on private estates, and the Department's thanks are due to owners and managers for their personal assistance. These co-operative experiments comprise manurial, spraying, shade, variety and pruning trials, and selection of promising or disease-resistant plants.

At one or more of the coffee stations experiments are being undertaken on shade, spacing, planting methods, the supplying of established plantations with seedlings, the correlation of seed of germination and early growth with behaviour of the mature tree, soil conservation, manuring, mulching, and size of bushes.

The shade versus no-shade experiment at the Kitale sub-station is now a good demonstration of the necessity for shade in that coffee district. The supplying method experiment

at the Scott Agricultural Laboratories, two years from planting, shows that seedlings are doing better than rejuvenated trees. A ball of earth round the seedlings' roots and planting in 2 feet cube holes appears to be the best method of establishment.

Varieties, Selections and Types

Fifteen types are under observation at both the Scott Agricultural Laboratories and the Thika sub-station. A variety and type trial similar to that at the Thika sub-station was planted at the newly opened Makuyu sub-station. Five types were planted in a trial at the Nandi sub-station. At Kitale a number of types specially selected for high yield and resistance to Elgon die-back and coffee-berry disease are under trial.

Selection and Individual Tree Recording

Recording for crop, growth measurements, etc., of selected individual trees was continued at the Scott Agricultural Laboratories. In co-operation with the geneticist at Amani, thirty trees, which are special Amani selections, are being recorded. At the Nandi sub-station the search for trees resistant to coffee-berry disease, was continued. Fifty-six trees, found in four estates, have some measure of resistance; these trees are being recorded individually. Six hundred and ninety-four trees are now under observation for yield and quality at the Thika sub-station.

Pruning

Pruning experiments were continued at all stations. Matters being investigated included the establishment of a multiple of stems by various methods, the comparison of the multiple and the single stem systems and conversion from the single to the multiple stem system.

Vegetative Propagation

The co-operative experiment, partly on the technique of, but especially on the best period for, top-working coffee plantations, started in 1937, was concluded in October, 1938. It was proved that top-working can be commercially successful.

The multiplication of clonal material at the Scott Agricultural Laboratories was accelerated by the installation of a block of electrically heated propagators.

The technique of striking cuttings is complicated. One factor is the use of growth substances. A new technique was evolved at the Scott Agricultural Laboratories for the treatment of cuttings with growth substances. This method depends

on the breaking of a vacuum surrounding cuttings which are in a solution of the substance. The incoming air forces the substance into the cuttings.

At the Thika sub-station scion material of *C. columnaris*, Jackson's hybrid, Harar, KsB, KsA and Mocha clone was grafted on to the French Mission type, two methods being used. An investigation was begun to discover the best season for grafting.

At the Nandi sub-station various media for striking cuttings and various types of cuttings were experimented with. A mixture of sand and loam was best. At this station grafting and inarching experiments were made as part of the preliminary work necessary in the perfection of the technique for conversion of existing plantations to a type resistant to coffee-berry disease. Climatic conditions in Nandi make grafting a comparatively simple matter. In the Cherangani District the same problem of conversion of existing plantations has to be solved. Inarching of coffee-berry disease resistant scions is being tried at the Kitale sub-station.

Spraying

The 1938 results of the experiment with carbide Bordeaux spraying, using headland pumps, have justified expectations of improved yields. Striking results in the retention of green leaf in the sprayed blocks were obtained in the 1938 drought. Fog-spraying was also under investigation.

At the Thika sub-station study was commenced of the relative effect on leaf fall of Bordeaux fog spray and sulphate of ammonia, and of the relative value of copper sprays and Bordeaux mixture. Tree appearance two months after spraying indicated that 40 per cent Bordeaux fog spray is as effective as the proprietary articles. It is very much cheaper.

At the Nandi sub-station colloidal copper sprays were under test in comparison with 1 per cent carbide Bordeaux. Results will be obtained after the picking of the 1938-39 crop.

Another investigation is designed to compare the Savani method, i.e., spraying after flowering and then two to three weeks later, with the more common procedure of spraying before flowering and then again after flowering. An experiment comparing the effects of shade and spray was started.

Spraying experiments were also begun at the Kitale sub-station.

Soil Treatment and the Mealy-bug Ant

A long range experiment was started at Thika to test the supposed influence some soil treatments have on the habits of the mealy-bug ant (*Pheidole punctulata*).

Flavouring of Trans Nzoia Coffee

In the past few seasons the flavour peculiar to Trans Nzoia coffee has caused it to sell at £10-15 per ton less than the price of normal Kenya coffee. At the instigation of the Trans Nzoia Coffee Planters' Association an investigation was started with the 1938/39 crop to discover if fermentation or factory preparation is responsible for the flavour.

Mealy Bug: Grease Banding

Trials showed that complaints that the banding greases on the market are of low quality or ineffective are not well founded, but there is some evidence that some batches of certain brands are not up to standard.

Mealy Bug: Biological Control

Mr. Melville went to Uganda and the Congo to discover coffee mealy bug parasites and predators. He found that evidence showed that mealy bug was indigenous or a very old introduction to Uganda and that it is there maintained at a low population level by a considerable number of primary parasites. From the material he sent to Kabete nine primary parasites were reared. Of these four were of particular importance and these were produced in sufficient numbers for liberation. By March, 1939, 65,000 parasites had been liberated.

White Borer Campaign, Makuyu

At the request of Makuyu coffee planters, another white borer campaign was undertaken on the same lines as the 1937 campaign.

Potash Status of Kikuyu Red Loam

This, the major coffee soil in Kenya, was found to have a very good reserve of potash, much of which is readily available. Analyses have shown that average application of bulky organic manures are more than sufficient to maintain the supply of potash.

Stream Pollution

Field and laboratory work on the reduction of the pollution of streams by coffee factory effluents, carried out by the Soil Chemist in collaboration with Mr. H. E. Carrick, Hydraulic Engineer, Public Works Department, was completed, and a full report was published in the *Coffee Board Bulletin* and the *East African Agricultural Journal*.

Elgon Die-back

The investigation of this condition was continued on the Kapretwa Estate, Mt. Elgon, by the Plant Pathologist.

A full report on all coffee work will be found in Volume II of this report.

MAIZE

Cultural Investigations, Nakuru District

The trial which was started in 1936 at Rongai to test the general effect of the ploughing in of maize trash and which had already indicated the value of this treatment for increasing maize yields, was continued in order to discover the cumulative effect. Owing to exceptionally dry weather during the trial, it did not provide conclusive results in 1938, and it will therefore be continued next year.

The maize composting investigation was continued at Rongai. Results show that the residual effect of compost is still valuable in the third year after application, but that in the fourth year compost in the amounts used in these plots has been used up. It must be noted, however, that the fourth year was very dry. This trial also indicates that six tons of compost per acre is the minimum application likely to give satisfactory results under similar conditions.

The experiment started last year at Rongai to test the effect of planting maize in manured hills, which in the first year showed that maize so treated gave a yield higher than that of maize planted in flat land over which an equal quantity of manure had been spread and ploughed in, was continued. In the second year it was found that the residual effect of farmyard manure was still considerable in both treatments, but the beneficial effect of the better distribution achieved by ploughing also became apparent.

A new experiment was started in 1938 at Rongai to compare the effect on the yield of maize, sown after wheat, of ploughing the wheat straw in and of burning the wheat straw, at the same time observing the effect of applications of superphosphate and guano on the rate of decomposition of the straw ploughed in. While yields which were good in the circumstances were obtained, drought precluded the possibility of obtaining definite results.

Another new experiment started at Njoro was one designed to test the value of vetches as a green manure and interplanted in maize. This experiment will be continued next year.

Field Investigations in the Trans Nzoia District

The trial of the effect of lime on the growth of maize, with and without humus, was in its final year in 1938. There were six treatments replicated six times in one-twentieth acre plots in randomized blocks. The treatments were:—

- (1) Weeds 1935 (control).
- (2) Dung (4 tons per acre) applied 1936 before sowing.
- (3) Green manure (velvet beans) sown 1935.
- (4) Limestone (2 tons per acre) applied 1936.
- (5) Limestone (2 tons per acre) plus dung (4 tons per acre).
- (6) Limestone (1 ton per acre) applied in 1935 plus green manure (velvet beans) and limestone (1 ton per acre) applied in 1936.

Maize yields from these plots in 1936 indicated that only the dung treatments (Nos. 2 and 5) produced significant yield increases over the control and that no treatment was significantly worse than the control, although in the green manure treatment (Nos. 5 and 6) yields were noticeably lower. (The green manure cover was not very satisfactory in 1935.)

Residual effects were tested in 1937, but unsuitable weather conditions so reduced yields on all plots that no satisfactory conclusions could be drawn from that year's results. The residual effects were again tested in 1938. No treatment produced an increase in yield which can be considered to be significantly greater than that of the control plot.

The trial of the effect of phosphatic fertilizing on maize with and without humus was also in its final year. The layout was the same as that of the experiment described above. The treatments were:—

- (1) Weeds (control).
- (2) Green manure (velvet beans) plus 100 lb. per acre of Fisophos in 1935.
- (3) As (2), but 1 ton limestone per acre instead of the Fisophos.
- (4) Dung (4 tons per acre) plus 1 ton limestone per acre in 1936.
- (5) Weeds 1935 plus 100 lb. per acre Fisophos in 1936.
- (6) Weeds 1935 plus 100 lb. bonemeal in 1936.

Significant results were obtained in 1936 from this experiment, which showed that the artificial fertilizers used had no beneficial effect whatsoever. A fifty per cent increase in yield was produced by the dung application and this is significantly better than all other treatments. The two green manure treatments also produced yields significantly greater than that

of the control plot. Green manuring can help if a growth sufficiently luxurious for ploughing in is obtained, but even at best it cannot give such good results as dung compost.

The residual effects were tested in 1937, but again weather conditions spoilt results. Nevertheless, the dung plots still showed a 38 per cent yield increase over the control and even in 1938 gave a significant yield increase.

The dung used in both of these experiments was fresh cattle manure made up mostly of Napier fodder, well trampled in a small night *boma* and stacked outside each time the *boma* was cleared out.

An experiment to discover what is the best green manure for maize under certain conditions, and to study the effect of phosphates on green manure and on the succeeding maize crop, was started in 1938. *Tephrosia*, soya bean, lupin and sunflower were the green manures used. All green manures were sampled and weighed before being ploughed in in September and oven dry weights of the samples were recorded so that dry matter per acre ploughed in from such type of green manure can be calculated. The results of this experiment will be published in the next report.

Another experiment started in 1938 was one to study (a) the influence on subsequent crops of the time of ploughing in of green manure; (b) the effect of phosphates on the bulk of green manure; and (c) the relation between the weight of green manure ploughed in and the effect on the subsequent crop. Results will be available next year.

Other experiments started in 1938 had as their objects:—

(a) The comparison of the effects of interplanting maize with green manures and of green manure leys of various types at different periods:

(b) The comparison of the effect of different maize spacings with different green manures.

No significant results were obtained from the latter, or from the former in its first year.

Maize Stalk Borer

No reports were received in 1938 of this pest causing damage to maize. Dry weather in the latter months of the year caused maize to ripen off rapidly and facilitated harvesting. This gave farmers the opportunity to remove all stalks from the land several weeks before sowing the 1939 crop. Attacks of stalk borer in 1939 may thus be anticipated to be slight.

Maize Breeding

Two randomized block trials, one at Njoro and one at Kitale, were planted with the progeny seed from a large number of double crosses. Damage by cutworm at Njoro and by drought at Kitale prevented any statistical treatment of the results, but a number of crosses yielded far in excess of the controls. These particular crosses will be repeated and subjected to further trial in 1939.

A further series of double crosses was made at Njoro and will be tested in 1939.

The synthetic varieties (mixtures of pure lines) at Kitale failed to show complete resistance to white blight and they will be selected again for this character.

Maize Seed Competition

The 1938 seed competition, in collaboration as before with the Royal Agricultural and Horticultural Society of Kenya, was conducted at Kitale, Njoro and Crater Stream. The competition was satisfactory, except that dry conditions were experienced at Crater Stream in the early growing season. The yields were as under:—

				Highest Yield	Lowest Yield
				<i>Bags per Acre</i>	<i>Bags per Acre</i>
Kitale	..	..	..	15.46	11.31
Njoro	..	..	..	15.93	13.29
Crater Stream	..	..	..	17.16	14.34

Wheat

The season was again fair for wheat, good crops being reaped over most of the country. A few districts suffered badly from rust and drought. The acreage sown was approximately equal to that sown in 1937 and the average yield is estimated at about four bags per acre. In the Trans Nzoia the crop suffered severely from locusts, damage being estimated at £10,000.

In view of the lateness and paucity of the rains in the lower altitude districts, in which crops are normally harvested first, it was anticipated that the mills might experience a temporary shortage of wheat in the early part of the season until the main crop was fit to mill, and 1,450 tons of wheat were therefore imported, to fill the gap.

Several new varieties were under trial on some scale by farmers. These included wheats Nos. 117.A., 130 B.613, a Canadian hybrid Double Cross x Ceres 721, and Reliance. The variety Sabanero again represented 15 per cent of the crop.

Rust and Other Pests and Diseases

Rust.

The new form of stem rust (K5) was present throughout the country and was found to have reached the top altitudes of 8,000 feet. Fortunately, the damage done was not on the whole serious, though some of the lower altitude areas suffered severely and the new wheat No. 58 was badly affected, as before.

The rust studies in co-operation with farmers revealed the presence of form K5 in every case where rust was present and this form was recorded seventeen times. The field differentials for forms K2 and K4 are unfortunately susceptible to form K5 as well, so it was not possible to determine whether either of these forms was also present. However, rust samples collected in the field and sent down to the pathological section at the Scott Agricultural Laboratories revealed the presence of form K2 on two samples, so it is likely that form K2 was also present to some extent over the country. Form K3 was recorded once late in the season. It would appear that form K4, which was epidemic several years back, was in abeyance during the year.

Artificial rust epidemics were again created in the breeding cases at Njoro and the Scott Agricultural laboratories by the Pathological section. The natural form of stem rust present, K5, was however dominant, and the other forms utilized did not spread well.

Yellow rust was generally severe and caused damage as low down as the 7,000 ft. level. Leaf rust, whilst present, was not severe.

Because of wet weather at the time of flowering and when the grain was setting, black chaff and flume blotch again damaged early-sown wheat in some areas.

Take-all was still present, but on the whole was not serious. Crop rotation, the best means for its control, was practised wherever possible. Much take-all infested land at the higher altitudes has been put under pyrethrum. At the Plant Breeding Station, Njoro, an experiment on the control of take-all by crop rotation was continued.

Experiments on the control of root rot of wheat were also continued at Njoro. In 1937, negative results were obtained from attempts at control by the application of various fertilizers. In 1938 the effect of soil sterilization by burning was tried, again with negative results. In 1939 the possibility of deficiency of certain minor elements in the soil being the causative effect of this condition will be investigated.

Breeding.

The appearance in 1938 of the new race of stem rust (K5) described above, in epidemic form, afforded the opportunity for a thorough test of the behaviour of all the hybrid wheats to it. As was anticipated, most of the progeny of the older crosses showed susceptibility, but rust-resistant plants were obtained from the newer crosses made since 1935.

Most of the varieties in general cultivation showed susceptibility, but Kenya Governor, Golden Ball and Equator were less susceptible, and Sabanero was generally resistant.

Three varieties of which seed supplies were limited were grown for trial and multiplication, as they showed promising resistant characteristics and might be used as a stop-gap against K5. These were No. 117.A. (Njoro hybrid x Marquis), Double Cross x Ceres 721 and Reliance. Of these, 117.A. showed complete resistance to K5, and all other forms of rust except K3, to which its resistance was less marked. It is a medium early variety, suited to altitudes of 6,000–7,500 feet. As its baking quality is only moderately good, mills will probably only be able to deal with a limited acreage, as in the case of Sabanero. Double Cross x Ceres 721, at medium altitudes, was not badly infected; at lower altitudes infection was more severe in some cases. Two rust-free strains of it, selected in 1937, showed complete resistance to K5 this year. Further selections were made. Reliance, although susceptible to rust form K3, and previously not recommended for cultivation, is resistant to form K5, and it is therefore thought that it may be of temporary use.

Three other wheats, of which only small quantities of seed are available, were multiplied at Njoro. They are Australia 26A, a Kenya-Australian hybrid, bred in New South Wales, which showed resistance to form K5 in the field, and the two Simpsons selected strains, which are resistant to forms K4 and K5 of stem rust. These are known as Simpson's L3 and Simpson's Rongai. Both are early, suited to lower altitudes, and are in the "strong" wheat class for baking. Both,

however, are susceptible to yellow rust and are only moderate yielders. They have been developed from similar natural hybrids found by Mr. H. Simpson of Rongai, in a crop of Kenya Standard, which was destroyed by form K4 of stem rust.

At Njoro and Molo the multiplication of seed of several other wheats was begun in 1938. Several show promising rust resistance. Rust resistant single plant selections from recent crosses were made and also a series of single and double crosses were grown and rust-free selections made. New crosses include some with *Triticum timopheevi*, which showed resistance to all rusts in 1937 and 1938 at Njoro and Molo.

Selections of rust-resistant plants from crosses were also made at the Scott Agricultural Laboratories. The two Simpson strains were multiplied there.

Another large collection of Australian-Kenyan hybrids was received from New South Wales. Unfortunately, all were susceptible to form K5 of rust.

At Njoro and Molo a number of imported wheats were tested for their behaviour to yellow rust at a high altitude. Four new wheats from Canada, Coronation, Apex, Renown and Thatcher, were grown, together with the variety Hope, at Njoro. Of these, Apex and Coronation showed at Njoro most resistance to rust and selections of these will receive further trial. At the higher altitude of Molo only Apex showed any resistance to yellow rust. This wheat is promising if its susceptibility to black chaff under Kenya conditions is not too great.

Yield Trials.

The usual yield trials of the more promising wheats were again made at Njoro, Molo, Rongai and the Scott Agricultural Laboratories.

Fertilizer Trials.

Trials at Njoro and Molo of the effect of superphosphate and bone meal on wheat growth were made. At Njoro the trial indicated that wheat was able to make good use of the readily available superphosphate, while the bone meal was too late, if indeed it was ever available. This trial will be repeated over a number of years to enable climatic conditions and interaction to be gauged. In the Molo trial phosphatic fertilizers appeared to decrease yield. The trial will be repeated in 1939.

OATS

The Australian variety Lampton again maintained its stem rust resistance at the high altitudes, but was moderately attacked by stem rust at Njoro, where most of the other varieties rusted badly. The Rhodesian strains S.E., S52 and A.E.S. Kherson oat were susceptible to stem rust at Njoro and Molo.

Control of Smut

Two Imperial Chemical Industries preparations were tried on Biffen's oat known to be infected with smut. The results indicated that both preparations were effective in controlling the disease; whereas the control plots (untreated) were heavily attacked, the treated plots were almost entirely free from infection.

BARLEY

The Pryor barley imported from Australia in 1937 was multiplied and issued to farmers. It appears to be suitable where a quick-maturing type is required. Of the slower maturing types the true type of Chevalier, obtained from the National Institute of Agricultural Botany, Cambridge, in 1937, gave the second best yield, the best yield being Spratt's Archer, which is, however, slower than the other. The true Chevalier type is being multiplied.

A trial of six varieties was made at Njoro. Pruor and an old importation of Chevalier matured in the quickest time—four to four and a half months. The true Chevalier type took four and a half to five months and the remaining three varieties—Beaver's Golden Archer, a variety from Suttons, and Spratt's Archer—all took five and a half months. The true type Chevalier yielded as well as the later barleys, while being comparable with the early ones in maturity.

SISAL

As mentioned in Part I, work was begun on the establishment of the new High Level Sisal Research Station at Thika. The work there will be the investigation of agronomic problems at high elevation. The investigation of agronomic problems at lower elevations continues at the Sisal Research Station at Mlingano, Tanganyika Territory.

The investigation of the retting of sisal flume tow initiated in 1937 at the request of the Sisal Industry Committee, and undertaken by the Chemical Section of this Department, proceeded, and may now be considered to be complete. A confidential report on the whole process was submitted to the Kenya Sisal Growers' Association. This work

indicated that an investigation of the more complete utilization of the sisal plant would be valuable. This investigation was undertaken. Some interesting products have been obtained which, while still in the experimental stage, have aroused great interest in the trade. For instance, a fibre produced from the dry leaf butts, which remain on the dead poled plants, promises to be of value in the upholstery trade, and is understood to have aroused great interest at Lembeg. Experiments on the utilization of sisal fibres as a reinforcement of concrete were started with the kind assistance of Mr. R. H. Paige. Results so far are interesting, and may be valuable.

PYRETHRUM

Generally speaking, the year was a good one for this crop, but at the beginning of the year the pyrethrum content of the general average of Kenya pyrethrum dropped to just about the marketing standard (1.3 per cent), and occasionally fell below it. This continued until the end of June. From the beginning of July until the end of October the pyrethrin content was very satisfactory, but at the beginning of November another drop occurred. The reason for this drop in pyrethrin content has not yet been fully investigated, but it is probable that it is caused by failure to cut back and so rest plants in the dry season, by the picking of immature flowers, and by faulty drying methods. Experiments at the Scott Agricultural Laboratories over the last two years have shown that there is a progressive drop in pyrethrins as the season advances. Forcing the plants to continue cropping produces the effect of a long-flowering season. Growers have been warned of the importance to the industry of employing sound methods.

It will be recalled that in 1937 the sale of pyrethrum under a marketing standard of a minimum pyrethrin content of 1.30 per cent was established, and that this at once resulted in a premium of about 45 per cent over Japanese pyrethrum. This premium was maintained in 1938, but towards the end of the year the agents were not in all cases able to guarantee a 1.5 per cent minimum pyrethrin content. The new lower rates of payment for low grade flowers decided on by the Pyrethrum Board should go a long way towards convincing growers of the need for care and proper attention.

At the Scott Agricultural Laboratories the analysis of the pyrethrin content of pyrethrum flower samples is done by the Gnadinger-Corl copper reduction method. The use of this method is still adversely criticised, but experience with several other methods has confirmed the opinion that the method used

is as accurate as any other, is no more difficult, and requires very much less apparatus and space. Nevertheless, the investigation of other methods, possibly more accurate, continues.

A survey of pyrethrum growing areas was planned for 1938. Owing to lack of staff, and of full co-operation by growers, the results of the survey which was made are not conclusive. It is hoped at a later date to conduct another survey on very much wider lines. From the survey completed, it appears that the two best districts for pyrethrum growing are Nyeri and Nakuru. Pyrethrin content of flowers from these districts was comparatively very high, being about 2 per cent at the beginning of the season, and not going below 1.47 per cent at the end of the season.

Selection and Breeding

In selection work, high pyrethrin content was the character chiefly borne in mind, but high yielding character was also taken into account. The best of the selected material was propagated clonally. Of twenty-seven lines of pyrethrum, eight were chosen with a pyrethrin content of over 1.40 per cent, and another eight with a pyrethrin content of over 1.30 per cent were also retained. The pyrethrin content of some of the lines selected is very high indeed, two of them approaching 1.80 per cent.

The need for selection is definite, as it has been found that continuous selection improves both flowers and pyrethrin content.

It was demonstrated that high pyrethrin content is not likely to be maintained by the use of open pollinated seed.

Another investigation aimed at discovering to what extent fertilization affects pyrethrin content. Preliminary results indicate that the content is the same whether the flower is fertilized or not, but that the quantity of pyrethrins is increased in the case of open pollinated flowers because of the development of achenes after fertilization. Further tests are being made to obtain confirmation of this.

A breeding programme comprising the hybridization of high content lines was carried out at Njoro. Viable seed was obtained from both natural and artificial crosses. This seed will be grown and the pyrethrin content of individual plants will be ascertained. The pyrethrum industry through the Board will assist this work by the grant of funds to be used to defray in part the cost of extra staff for the Chemical Section of

the Department. In all breeding and selection work the Chemical Section must necessarily help; it is essential that the produce of each selection be analysed at intervals to ensure strains of high pyrethrin content.

Cultural Experiments

Investigational work on the culture of this crop was again undertaken mainly at the high altitude plots at Molo. The experiment on the effect of cutting back (1937-38) has indicated that, in field practice, this is necessary and that by cutting back early a better distribution of crop is obtained. Very low cutting decreases yield. The 1937-38 spacing experiment showed that $2' \times 2'$ was the spacing which allowed for thorough inter-cultivation with a minimum reduction of yield, but this superiority is probably offset in practice by the lower cost of weeding in wider spacing. The 1937-38 splits versus seedlings experiment indicates so far that a higher yield of dried flowers is obtained from seedlings than from splits. Splits obtained an initial advantage because of their earlier flowering.

Drying

In 1937, as a result of the collaborative work of Messrs. R. O. Barnes and F. McNaughtan, a modified Ainabkoi drier was evolved. Complete working plans of it were prepared by Mr. Barnes. Complaints about this drier have been received, but in every case of complaint it has been found that the specifications were not adhered to, and that ventilation had been reduced. Correctly built, according to specification, the modified Ainabkoi drier is very efficient and produces 250 lb. to 300 lb. of properly dried and perfectly coloured flowers daily.

Pests and Diseases

Thrips attacked pyrethrum on individual estates in several areas within the Colony, namely, Mt. Elgon, Sabatia, Sabukia and Limuru. Under favourable climatic conditions this insect appears in epidemic form and results in the withering of the leaves and browning of the flowers. This latter condition is due to the entrance of a fungus *Alternaria gossypina* as a result of thrips attack. Owing to the rapidity with which this insect breeds under favourable climatic conditions and its occurrence within the disc of the flower and the under-surfaces of the leaves, spraying is considered uneconomic except in the initial stages of an outbreak.

PASSION FRUIT

This industry progressed during the year. The Kenya Farmers' Association (Co-operative), Ltd., factory at Kitale, for the production of juice, was completed and commenced work in December. Three other factories are working in the passion fruit areas. "Woodiness" disease caused increasing alarm and will be a menace to the industry until it is controlled. What is being done to eliminate it is described below. A series of cultural experiments were conducted at Kitale.

Selection and Cultural Experiments at Kitale

Individual Vine Records.

Fruit records were made on 220 individual vines, the object being selection for yield and disease resistance. Plants yielded an average of 401 fruits in the year, the highest being 188 per cent and the lowest 26 per cent, taking 100 per cent as the average.

Soil Treatment.

Four observation plots were planted. The treatments were:—

- (a) Compost—Gave 466 fruits per vine.
- (b) Clean weeding—Gave 412 fruits per vine.
- (c) Mulch—Gave 377 fruits per vine.
- (d) Green manure—Gave 349 fruits per vine.

These results are not statistically significant, but nevertheless support the assertion that passion fruit requires a soil rich in organic matter for good yields.

Pruning Methods.

The objects of this experiment are to study the reaction of vines to different systems of pruning and to evolve a compromise between efficiency and cost. The results so far appear to show that, when a plant is still young, pruning has very little effect in increasing bearing. The methods used varied in the time taken to prune from two hours to fifteen minutes. Even the most severe pruning did not cause vines to suffer an immediate setback, but after a long, dry spell later on, vines which had not been pruned, or which had received practically no pruning (treatments (d) and (e) below) were standing up better and suffered much less from leaf fall than the more severely pruned vines. The methods are:—

- (a) Very careful, ensuring even curtain of evenly spaced droppers, no contact with neighbouring vines, no crossing between wires. "Super" method.

- (b) As (a), but not with such meticulous care—"standard" method.
- (c) A simple "rule of thumb" method (1) all shoots growing up across wires to be removed and (2) bottom tips of curtain to be slashed off clear of ground; no attempt made to thin or select "droppers".
- (d) No pruning, but bottom tips of curtain to be kept slashed clear of ground.
- (e) No pruning at all.

Soil Deficiency.

This experiment is being undertaken by the Agricultural Officer, Kitale, in collaboration with the Senior Agricultural Chemist, and was started after the second outbreak of "woodiness" in the Trans Nzoia, when it was thought that that disease might be due to a soil deficiency, because in diseased plantations it was frequently found that both top soil and sub-soil were very acid and that the roots of older plants were reluctant to enter the sub-soil. The treatments were:—

- (a) Twenty-four seedlings were planted on sites of previously growing "diseased" plants, and subject to the following soil treatments; the treatments were randomized and replicated three times:—
 - (1) No treatment of subsoil.
 - (2) Subsoil dug over to depth of 1 foot.
 - (3) Subsoil dug over to depth of 1 foot and mixed with 5 lb. ground limestone.
 - (4) Subsoil dug over to depth of 1 foot and mixed with 5 lb. wood ash.
 - (5) As (1), plus 1 *debe* of *boma* manure mixed with top soil.
 - (6) As (2), plus 1 *debe* of *boma* manure mixed with top soil.
 - (7) As (3), plus 1 *debe* of *boma* manure mixed with top soil.
 - (8) As (4), plus 1 *debe* of *boma* manure mixed with top soil.
- (b) Four existing vines were subjected to the following different soil treatments:—
 - (1) No treatment.
 - (2) Subsoil dug over between 2' and 3' from vine.
 - (3) Subsoil dug over between 2' and 3' from vine plus 5 lb. limestone.

- (4) Subsoil dug over between 2' and 3' from vine plus 5 lb. wood ash.

None of these soil treatments exercised any control of "woodiness" or induced the resistance of plants to it. By the end of the year all plants in the experiment station had become diseased.

Cultural Experiments in the Njoro Area

Pruning systems are being tested, but it is too early yet to give definite results. A thatching and green manure trial was conducted at Rongai. It was noticeable that thatching produced a distinctly beneficial effect in the early part of the season, but that later on there was no obvious difference in effect. The green manures used—purple vetch and blue tick cowpea—did well, but had no obvious effect on the vines.

Diseases.

The incidence of "woodiness" disease of passion fruit increased in 1938. In the Trans Nzoia it is estimated that approximately one-third of the acreage is now affected. The investigation of the nature and means of control of the disease was pursued by Dr. Nattrass of this Department, and Dr. H. H. Storey of the East African Agricultural Research Station, Amani. In September preliminary recommendations for control were drawn up, but these are only intended as a stop-gap until a real solution of the problem is found.

A scheme of co-operative research was initiated. While final conclusions cannot yet be drawn, it is already proved that the disease in the Trans Nzoia is caused by a transmissible virus (this is not yet proved for the Sotik area, but is suspected) and the occurrence of two or more strains of the virus is suspected. As far as is known, the disease is not carried in the seed or in soil which has borne diseased plants. The approach to the problem is twofold; (1) the investigation of possible immunity of various species and strains of *Passiflora*: (2) the investigation of the effect of soil conditions on the incidence of virus.

The preliminary recommendations for control were, firstly, the planting of disease-free material; secondly, the destruction of diseased plants; thirdly, the avoidance of spreading the disease by handling and pruning. Plants affected must be cut off at ground level and burnt, the roots subsequently being dug up and destroyed. There is a danger of the roots of diseased plants which have been cut off again producing new shoots which are infected.

Recognition of the disease is complicated by the fact that certain of the symptoms can be masked or simulated by physiological disturbances in the plant caused by poor soil conditions, drought, over-bearing and, possibly, a deficiency in some essential minor element.

Other fungi causing diseases of passion fruit of minor importance were recorded. The conditions caused by such fungi include leaf spot, lesions on fruit and leaves, root rot and stem canker.

Draft rules for the control of hygiene in passion fruit factories were prepared in 1938.

Storage of Passion Fruits.

An experiment on the storage of passion fruits was carried out by the Agricultural Officer, Njoro. The period of storage, for all methods, was three weeks. Fruits picked off the vine were classified and stored separately as follows:—

- (a) Fully developed but still green.
- (b) Fully developed but one-third coloured.
- (c) Fully developed but two-thirds coloured.
- (d) Fully developed and fully coloured.

Ripe fallen fruits picked from the ground but still smooth were also included in the trial.

Three packing methods were used for each of these classes of fruit, as under:—

- (1) Wrapped in glassine paper.
- (2) Dipped in wax.
- (3) No treatment.

Storage was at room temperature, having a diurnal variation of 70°F. to 55°F. These are typical storage temperatures.

After three weeks' storage, the experiment demonstrated that:—

- (1) Picking fruits at different stages of maturity has no differential effect on the degree of wrinkling after two to three weeks of storage.
- (2) It is possible by suitable means, e.g. wax, to control wrinkling in fruits at all stages of maturity, including fallen fruits picked off the ground.
- (3) Dipping fruits in wax not only controls wrinkling, but preserves their original colour.
- (4) Wrapping in glassine paper is ineffective in preventing wrinkling, but does affect the rate of colour change to a slight extent.

After seven weeks' storage, the waxed fruits were tested for flavour. The best flavour was that of fruits fully developed but two-thirds coloured when picked. Their flavour was excellent and very sweet.

The conclusion drawn finally from the experiment is that two-thirds coloured, waxed fruits are probably best for storage purposes.

TOBACCO

Leaf Tobacco

In collaboration with the British American Tobacco Company, three small experimental plantings for flue curing were made in the Makuyu area. A temporary barn was erected in which the leaf was cured. The leaf produced is thought to be of good quality; at the moment of writing a full report and valuation of the leaf is awaited from the British American Tobacco Company. On receipt of this report it will be decided, whether the Makuyu experiment shall be expanded to seven acres in 1939, with a proper barn in that area to be erected with the assistance of Government funds.

Tobacco for Nicotine

The production of high-nicotine content leaf for use in insecticides is one of the smaller agricultural industries of Kenya. The crop is chiefly grown in the Njoro District; selection for high nicotine content strains was undertaken at the Plant Breeding Station, Njoro, in collaboration with the Chemical Section, Kabete, the plants used being from seed of the best plants at the Scott Agricultural Laboratories in 1937. The crop at Njoro did fairly well, yielding over 600 lb. of dried leaf per acre in difficult weather conditions. The nicotine content of the bulk crop of dried leaf was 10.4 per cent. Selected plants had nicotine contents varying between 10 and 15 per cent, calculated on the dry basis. The best plants were self-pollinated to obtain seed for further trial, with a view to the production of selected high-nicotine content strains. The introduction into general cultivation of a really high nicotine content strain is of importance, because the price of the leaf produced by the grower is based on its nicotine content. For the same reason analyses of individual commercial consignments are necessary. It is interesting that these analyses revealed that at the beginning of the year nicotine content was comparatively low, but towards the end of the year some very high contents were recorded; for instance, two samples contained, on the dry basis, 14.8 and 14.9 per cent nicotine.

TEA

The examination of a large number of soil samples taken from the Nandi, Kaimosi and Kipkarren districts, indicated that part of the Nandi and Kaimosi districts are definitely suitable for tea growing. Conditions in the Kipkarren district are variable and unsuitable for tea growing. A similar survey of the North Sotik and Kericho areas is not yet completed.

FLAX

Plantings for flax for the production of pedigree seed for export were of about the same acreage as last year. Owing to the possibility of the provision of central factories to deal with the fibre, many growers did not export their seed, but hope to sell it locally. Only two varieties are now grown, viz., Liral Crown and Stormont Gossamer.

Flax rust testers remained free from infection in the Njoro area.

Proposals for development are mentioned in Part I.

MISCELLANEOUS CASH CROPS

Ramie

A ramie fibre producing industry which was mooted in 1936 remains undeveloped because, despite the extensive inquiries and investigations undertaken by the Department in the past three years, no cheap and satisfactory method of decortication has yet been found, and the processes which do away with decortication cannot for the present be established in Kenya. For this reason, planting of ramie has ceased, although a number of small plantations are still in existence. The hope of establishing this industry has not yet been abandoned; the discovery of a suitable method of decortication or other treatment is by no means improbable.

Derris Root

This crop is still in the experimental stage. The acreage remained extremely small in 1938, but as supplies of cuttings of a good strain become available at Amani it is anticipated that plantings will increase. The two areas in Kenya which are believed to be specially suited to derris cultivation are the coastal strip and the Songhor-Koru area. In 1937 the importation of seed or planting material of derris was prohibited except under permit, with the object of preventing the importation of strains having a low rotenone content.

Oyster (Kweme) Nut

In the year under review great interest was aroused in this crop, largely as a result of the efforts of Mr. W. J. Poppleton of Makuyu, especially in the Makuyu District, a marginal coffee area in need of a supplementary crop. The first European cultivation of the oyster nut was in the Usambara region of Tanganyika Territory, where planting started in 1935. In both Tanganyika Territory and Kenya the nut is used as a medicinal foodstuff by natives, but it is only found in a few localities.

As a result of the interest aroused at Makuyu and elsewhere in Kenya, there was a run on seed, the supplies of which are limited, and many purchasers failed to obtain the full supplies wanted. A small acreage of young plants not yet in bearing is now established, chiefly around Makuyu.

The Department of Agriculture undertook numerous inquiries and investigations relating to the oyster nut.

Decortication.—It is considered that hand decortication with a knife is quite economic, but a better method may be found.

Bitter Principle.—It was discovered that the bitter principle contained in the oyster nut's outer husk, which, if not removed, in time permeates the kernel, can be completely removed without any damage to the kernel, by the immersion of the nut in ordinary cold water for from five to seven hours.

Uses.—So far the oyster nut kernel has been regarded primarily as a commodity used by confectioners and chocolate makers. This Department is, however, investigating the possibility of its use as a vitamin-rich foodstuff. A use may also be found for it in cosmetic manufacture and in the household oil and dessert nut trades. It is thought that its vitamin content may be high and it is known that it has the effect of increasing the milk flow of humans. It is in fact used for this purpose by pregnant native women in certain parts of Tanganyika Territory. Samples were sent to the United Kingdom for investigation on these lines, and reports are awaited.

Packing and Marketing.—Samples of decorticated nuts in various packings were sent to London for report. Reports received indicate that the most acceptable packing for decorticated nuts is in 14 lb. or 28 lb. vacuum-packed tins. It is thought that nuts prepared in this way will fetch about Sh. 1 per lb. in the confectionery trade. As production increases it is thought that an adequate demand will be established.

Cascara Bark

Reports on samples sent to the United Kingdom through this Department indicate that Kenya cascara bark extract is equal in quality to the best American bark and meets medical requirements. Towards the end of the year, after the publication of this information in the local Press, one or two farmers applied for seed, which is obtainable in very limited quantities at certain times from the Scott Agricultural Laboratories and the Forest Department. Production of cascara bark in Kenya is still in its infancy, but there is a possibility of its being profitable.

Tung Oil

Plantations of *Aleurites montana* and *A. Fordii* exist in Kenya, but still remain to be proved as a satisfactory commercial proposition. Experimental plantations of both species exist at this Department's station at Kitale.

BEANS AND PEAS

*Resistance to Bacterial Blight in Haricot, Rose Coco
and Canadian Wonder Beans*

The resistant selections had a difficult season at Njoro. The resistant white haricot stood up very well to blight infection and yielded well above the average. On the other hand, the Canadian Wonder resistant selections nearly all succumbed to blight. Of those that survived, a small number of plants have been kept which may show complete resistance. None of the resistant selections of Rose Coco survived.

Madagascar Butter Beans

Selections for resistance to "yellow eye" were grown at Rongai and suffered from extremely dry conditions. Of a decimated stand a number of plants did well, and will be tried again next year.

Blue Tick Cowpea

This variety showed up to great advantage at Rongai. In one of the driest years on record it proved drought-resistant, making a good ground cover and yielding well.

ESSENTIAL OILS

Lavender oil is now being sold from Kenya. One or two samples were analysed during the year. Spike lavender grew well at Molo.

The production of oil from *Cymbopogon afronardus* is now progressing, and samples of the first oil are expected early in 1939.

FORAGE CROPS

Napier Grass

Trials in the Nakuru area in 1938 corroborated the earlier conclusion that the indigenous Napier grass gives the heaviest yield of all of green material in the shortest time. It is also considered that it is one of the most drought-resistant species available for use as fodder in this country.

Purple Vetch

In the Nakuru area purple vetch has proved itself to be the best of all the leguminous crops, both for cutting green and for hay. It is easily established with a minimum of cultivation even on poor land, and for this reason it should become popular.

Lucerne

Lucerne is the fodder crop with the highest protein content suitable for Kenya conditions, but it is exacting as to the conditions it requires. An investigation at Njoro into ways of increasing the yield of lucerne under dry land conditions showed that an application of *boma* manure at the rate of eight tons per acre gave an increase in yield of green matter of 13.7 per cent in comparison with an untreated plot, and that a similar application of *boma* manure, together with an application of complete fertilizer, gave an increase of 18.3 per cent. Applications of complete fertilizer alone and superphosphate alone gave no increase over the control plot yield of green matter. The actual yield of the control was half a ton of green matter per acre, in two cuts.

Sprouted Grain

In order to discover a way of speeding up germination and of increasing the weight of sprouted material, a new nutrient solution was tried in comparison with river water as a nutrient solution. Maize, barley and wheat were used. The result was negative; river water gave results which were as good as the new solution under trial. Barley and wheat proved to be better material than maize, barley being slightly better than wheat. Under conditions at Njoro it took three weeks for sprouted barley and wheat to be ready for feeding; maize took a week longer.

Hyparrhenia rufa

At Kabete the comparison of yields of a number of crops for purposes of storage, to supplement grazing in times of scarcity, was continued. While Napier grass (*Pennisetum purpureum*) remains the heaviest yielding type, the extremely

rapid growth of *Hyparrhenia rufa* results in more frequent crops than in the case of any of the other types under experiment. This species has the added advantage of easy and rapid establishment from seed.

PASTURE RESEARCH

Experimental Work on Pasture Grasses

Experimental work, conducted by or under the direction of Mr. D. C. Edwards, the Agricultural Officer in charge of Pasture Research, was continued on the lines indicated in previous reports, the main object of the work at Kabete being the production of pasture grass types suited for use in established pastures in mixed farming areas, both European and native, and a considerable number of new types has been placed under preliminary experiment.

The study of indigenous flora forms the basis of this work. Investigation has been directed mainly to the groups of ecotypes, most useful for conditions in this country, mentioned in the last Report (Part VI B, Vol. II, p. 63), which without exception comprise stoloniferous grasses. These ecotypes include six forms of *Chloris gayana*, three of *Pennisetum clandestinum*, and various *Cynodon* sp.

The Giant *Cynodon* has continued to give promise, and trials have been extended to widely different climatic areas. This species is probably most suited to the hotter districts and, owing to its strongly stoloniferous habit, it may prove of considerable value in the reconditioning of eroded native areas. A more recently acquired *Cynodon*, probably a variety of *C. dactylon*, is clearly more drought-resistant than varieties of this species hitherto obtained.

Several indigenous ecotypes of *Chloris gayana* and species of *Brachiaria* have shown promise.

Work on three ecotypes of Kikuyu grass, isolated in 1934, was continued. All three types withstand prolonged severe cutting treatment. A study of natural seed distribution of this species was begun.

An experiment was started in 1936 to test the reaction of a number of grasses, selected as the result of previous work, to a severe treatment of defoliation. Under this treatment the best are two local types of *Chloris gayana*, *Botriochloa insculpta* and *Pennisetum clandestinum* (Kikuyu grass). *Cenchrus ciliaris*, the Queensland type of *Chloris gayana*, and two local *Cynodon* sp. were distinctly inferior in this respect.

Trials of exotic species were continued at Molo. *Phalaris tuberosa* was outstandingly good, and *Bromus marginatus*, rye grass, cocksfoot and *Festuca elatior*, all did well. All of these species can be recommended for the high-altitude country round Molo and for parts of the Kinangop and Ol'Kalou.

Pasture Legumes

The difficult problem of providing pasture legumes suitable for sowing with the grasses has not yet been solved. The Rhodes grass-lucerne mixture is the one which can be most widely recommended for temporary leys. A number of types, both indigenous and exotic, have been placed under trial, and an *Indigofera*, as yet unidentified, has shown some promise of success. Breeding of lucerne, with the object of producing an adapted type suitable for use in pasture, was continued.

Reaction of Natural Pasture Types to Grazing

The study of this has brought to light further important information regarding the Kikuyu grass-clover relationship in the Kabete area. The properties of the indigenous clover, *T. Johnstonii*, were found to increase in relation to the intensity of the grazing, the sward having been improved by the heaviest grazing treatments. Experiments have shown that approximately one year of protection from grazing resulted in the disappearance of the clover, the Kikuyu grass then being replaced by other and less desirable species.

It was also found that a considerable proportion of the clover can be induced to return merely by the control of the rank herbage over a period of one and a half years, and that, further, this return of the clover results in a sward again dominated by the Kikuyu grass. These findings point to the necessity for intensive management of natural Kikuyu grass pasture.

Rhodes Grass

In collaboration with the staff of the Veterinary Training Centre, Ngong, an experiment was undertaken to compare established Rhodes grass with the local natural pasture for the purpose of fattening cattle.

Trials of Pure Strains and Mixtures of Grasses

In the Trans Nzoia a trial of pure strains and mixtures of grasses has been conducted for some years. The plots yet remain to be fenced and grazed individually, but nevertheless the whole field was heavily grazed throughout 1938. The two outstanding grasses are molasses grass and *Paspalum dilatatum*. The pure stand of the latter, planted in 1935, has

thickened into a good sward, remains fairly green in the dry season, and is very palatable to stock. Where these two species have been planted in a mixture the molasses tends to become dominant.

Pasture Establishment

An experiment was started in the Cherangani in 1938 having as its object the study of the laying down of old arable land to pasture for the purpose of restoring fertility and to get information on the carrying capacity of the different grasses. Half-acre plots on old maize land were planted as under:—

- (a) Natural reversion;
- (b) Molasses grass roots;
- (c) Local *Paspalum scrobiculatum* roots;
- (d) Local Star grass roots;
- (e) *P. dilatatum* (imported) seed;
- (f) Rhodes grass seed (Australian);
- (g) *P. dilatatum* roots.

The two best plots are, to date, the local Star grass (*Cynodon* sp.) and *P. dilatatum*, established from seed. Molasses grass has not filled up the gaps and *Digitaria* sp. has come in. Poor soil caused the Rhodes grass to make poor growth, and *Digitaria* has largely taken its place. The same applies to the local *Paspalum*. In the natural reversion plot, *Digitaria* sp. has become dominant. The plots will be fenced in 1939 and will be grazed individually, to afford an opportunity of judging the carrying capacity of the different grasses.

The investigation into methods used in effecting the reversion of arable land to grass, which was started at Njoro in 1936, was continued in 1938. The year was unusually dry, causing a restriction of grazing. Results indicate that the paddock land which was allowed to revert to grass naturally is rapidly becoming as good as the paddock planted with Star grass and Australian Rhodes grass. The Rhodes grass is giving way to Star grass.

In the planted paddocks at Njoro the dry season proved too much for *Paspalum dilatatum*, which was entirely dried up. The woolly finger grass did badly, becoming almost bare by the middle of the dry season. The large *Cynodon* sp. plot was conspicuous for the marked resistance to drought of scattered individual plants.

On the whole, however, this plot was not a success; the land is now mostly occupied by other grasses, notably *Hyparrhenia* sp. The Australian Rhodes grass plots survived the

severe conditions well. It can be said that Kikuyu grass and Rhodes grass are the only species which have stood the test of intensive management under the conditions at the Plant Breeding Station. At Rongai the local Star grass provided the best paddocks. Molasses grass provided a luscious feed at all times, even in the dry weather, and can be recommended for Rongai conditions. Rhodes grass and *Cenchrus cristatus* did moderately well.

Improvement of Natural Veldt

An experiment on the improvement of natural veldt was started at Molo, comprising the undermentioned treatments:—

- (a) Dressing of complete artificial fertilizer;
- (b) Phosphates only;
- (c) Repeated applications of nitrogen;
- (d) Used as a sheep *boma* plus complete artificials;
- (e) Used as a sheep *boma*;
- (f) *Boma* manure at 12 tons per acre;
- (g) Control (untreated veldt).

By the end of December all the plots which had been dressed with artificial fertilizers looked just as brown and unpalatable as the control plot. In the plots used as night *bomas* for sheep the natural veldt had been completely trodden out and Kikuyu grass had made its appearance. The sheep *boma* plots thus had a patchwork appearance, due to the scattered distribution of the green Kikuyu grass, but not to the same extent.

Investigational Work on Soils

Lack of sufficient staff in the Chemical Section made it impossible to continue in detail the nitrification investigation mentioned in last year's Report. Variations of ammoniacal and nitrate nitrogen, however, were studied throughout the year. As was anticipated, immediately after the beginning of the rains there was a very marked increase in the ammoniacal nitrogen, after which occurred a rise in the nitrate nitrogen. When rain was continuous, nitrate nitrogen was very rapidly leached out of the surface soil. As the rainy period continued the rate of ammonia formation tended to decrease. The nitrogen formation was not ascertained, but it, too, probably decreased in rate. The causative decrease in bacterial activity is probably due to an increase in the number of protozoa.

Arrangements have been made for an officer of the Department to spend a part of 1939 at Rothamsted to study

the latest technique for determining counts in bacterial numbers. On his return parallel work on the variation in ammoniacal and nitrate nitrogen and in bacterial numbers will be continued over a whole year. Meanwhile, it is intended to explore a technique whereby it will be possible to determine accurately the bacterial activity in the soil.

The importance of this work is that it may reveal the real reason for the difference between the results obtained from early and late planting; this may lead to suggestions for modifications in farming procedure.

Hedges and Trees for Shade and Shelter

The experimental shelter belts planted in 1936 and 1937 at Kitale have continued to make good growth. The standard belt of indigenous trees is disappointing, one species, *Calodendron capense*, having died out completely. It is proposed to replace this species with *Spathoda nilotica*, the Nandi flame tree.

Of the tall species in the recently planted windbreaks at Njoro, *E. saligna* is best, with *E. maideni* next, followed by *E. paniculata*, *E. rostrata*, *E. maculata*, and *E. sideroxylon*. Of the intermediate species, *Cupressus lusitanica* is better than *Cupressus Arizona* and *Cupressus torulosa*. The Pepper tree (*Schinus molle*) is also good. At Rongai, *Croton megalocarpon* is best, with the pepper and *Phytolacca* both good. *Angophora* and *Euphorbia tirucallii* are not in evidence; the latter is evidently relished by buck. *Grevillea*, too, both at Njoro and Rongai, never seems to get away on account of its attractiveness to buck.

For hedging, there is no doubt that Kei Apple is best, though the Mauritius thorn is quicker. At Njoro, *Bougainvillea* is slow and *Carissa edulis* is eaten down by buck and cattle. *Cotoneaster* is doubtful as yet.

Native Areas

GENERAL

The gradual but steady loss of soil fertility in the more thickly populated parts of the native reserves has caused concern. The loss was most apparent in the thickly populated parts of the Kikuyu districts, in Machakos and in the Maragoli-Tiriki area of North Kavirondo. It can be recorded that in 1938 a great improvement in the situation occurred in the South Nyeri, Fort Hall and Kiambu districts through the widespread use of manure as the result of this Department's propaganda and demonstrations. In the Maragoli-Tiriki area also a great advance was made and the way prepared for

future development in that the use of manure, stall feeding and paddocking were first begun in earnest by the more progressive cultivators. It will now only be a matter of time before their use becomes general.

It has been argued that this Department, with its crop improvement, marketing and inspection schemes, all leading to greater production, is responsible for the general loss of fertility, and that the sale of hundreds of thousands of bags of produce from the reserve will lead to ruination. When it is realized that, in the Central Province, to take an example, the production of some 628,000 bags of produce for sale is from a potentially good producing area of 2,700,000 acres, supporting over 200,000 families, the fallacy of the argument becomes apparent. If the present low standard of living is to be bettered, the sale of both crop and stock products must increase very considerably. With no large increase in population, better distribution and better methods of farming, the desired increase can be well supported.

The produce inspection scheme and organized system of marketing begun, with local differences, in the Nyanza and Central Provinces some three years ago have had far-reaching results in agricultural progress. The native will take little interest in his soil unless he is enabled to dispose of the extra production provided by the better farming methods which are now spreading.

The Senior Agricultural Officer, Central Province, writes:—

“Farmers are well known for their conservatism. The African agriculturist is no exception, and is very tenacious of the customs and methods practised by his forefathers. Only with the greatest perseverance and patience can he be induced to adopt new methods. Experience has shown that it is fruitless to expect immediate results from any new venture, however expedient. This fact has again been proved recently in the Machakos Reserve, where the expenditure of large sums of money on reclamation schemes, far beyond the understanding of the native, has borne little fruit and has even aroused a measure of antagonism.

“The agricultural progress made in Kitui, where an agricultural officer has been stationed since 1933 only, is astonishing. Better methods of cultivation, the widespread planting of cassava, the issues of better yielding seed, have greatly reduced the fear of famines so common in the past.”

It is noteworthy that in the Nyanza Province ploughing has become a trade, the plough and team owner hiring out his unit, with driver, etc., to cultivators. The fee is approximately Sh. 5 per acre.

In the year under review there was a certain amount of depression among native producers and traders caused by the all-round drop in local prices of some produce. The following figures show the quantities of produce known to have been sold from the native reserves in the Nyanza and Central Provinces and the value to the producer:—

PRODUCE	Nyanza Province	Central Province
	£	£
Maize	77,895	106,102
Wattle	—	36,660
Pulses	7,985	37,584
Potatoes	—	4,584
Cotton	90,220	11,209
Vegetables	5,000 (approx.)	6,000
Tobacco	—	499
Rice	559	—
Eleusine Millet	3,096	—
Firewood	3,000 (approx.)	—
Beeswax	—	2,029
Groundnuts	12,561	—
Sesame	13,182	—
Tobacco	332	—

In addition, revenue is derived from the sale of hides, skins and ghee.

FOOD CROPS

The main food crops grown are:—

Nyanza Province

Sorghum, eleusine millet, maize, gram, sweet potatoes, cassava, beans, bananas.

Central Province

Maize, foxtail millet, bulrush millet, sorghum, gram, beans, sweet potatoes, cassava, bananas.

Coast Province

Sorghum, millets, maize, sweet potatoes, bananas, cassava, rice, beans, gram.

The Department's work in food crops is many-sided. Firstly, there is the improvement of husbandry methods; this is referred to under Soil Conservation and Mixed Farming heads. Secondly, there is famine prevention, which is referred to under that head. Thirdly, crop improvement, described

under Improvement of Crop Varieties. Issues of seed of improved varieties of food crops are made annually. This work is noted under the head Seed Farms and Seed Issues.

Food Production in 1938

Nyanza Province

In most areas, the long rains were sufficient to produce an adequate supply of food, but in one or two places a local shortage occurred which was remedied by supplies from other areas. Drought later in the year made short rains harvests light.

Central Province

Food crops in the Kikuyu districts were adequate, but in certain parts of the Ukamba districts failures occurred which were remedied by supplies from other areas.

Coast Province

Heavy rains and floods in May made sowing conditions difficult and caused early sown crops to suffer. The food position at the end of the year was satisfactory.

SOIL CONSERVATION AND FERTILITY

The problems of soil conservation and the maintenance and improvement of soil fertility continued to be the first concern of the Department's staff. A distinct advance was made, in that a greater part of the population was made to realize the importance of the maintenance of soil fertility in its broadest aspect, and of the need for anti-erosion measures.

The measures employed may be roughly divided into four categories: (1) the prevention of erosion in arable and grazing land at present in good condition; (2) the reclamation of eroded areas; (3) the preservation of watercourses and supplies; and (4) afforestation. The most important means of achieving a high standard of soil conservancy is by the use of a satisfactory farming system, which ensures that soil fertility in its broadest sense is maintained. To achieve this is the aim of the Department in all native areas, but with the long-established husbandry systems which exist and with the difficulty of unsuitable land tenure, which has to be surmounted in many areas, it is an aim which it will take many years to achieve. The need in nearly all native areas is for the introduction of a mixed farming system.

Mixed farming, viewed in this way, falls into the first category of anti-erosion measures. In all three native agricultural provinces great efforts are being made to spread an understanding of the principles of mixed farming by propaganda and demonstration holdings and to persuade cultivators

to take it up. Considerable success was achieved in the Central Province, as is shown in the section of this part of the report which deals specifically with mixed farming, but in the Nyanza and Coast Provinces progress is much slower, as the difficulties are greater.

Soil Conservation in the Nyanza Province

Local Native Councils of the three Kavirondo districts towards the end of the year passed resolutions by virtue of which it will be possible to enforce the protection of land. So far, all that has been achieved has been done through education and persuasion. Two special courses for native agricultural instructors were held at Maragoli on the land covered by soil control demonstrations.

The most common preventive measures used on land under cultivation were the laying of crop refuse in contour rows (the burning of crop refuse was much less common than in past years), the digging of contour ditches with a raised bank on the lower side, and the establishment of living wash-stops on the top of the ditch banks, the placing of lines of stones along the contour and the check of water flow down boundary furrows running up and down hill between *shambas*. The majority of contour ditches were made by trained instructors, who first surveyed the site with a line level.

The actual number of fields or *shambas* at present in cultivation in which complete or partial anti-erosion measures were taken in 1938 is difficult to arrive at, but the figure for Central Kavirondo alone was 21,069.

An increase in the number of cases of voluntary control of grazing on communal grazing land can be recorded. The results were, in most cases, very satisfactory.

Equally rapid progress was made in the reclamation of areas already eroded and unfit for cultivation or grazing. At the two reclamation demonstration and investigational centres at Maragoli and Buholo, in North Kavirondo district, paid labour was employed, but elsewhere the work was done by voluntary labour, money only being spent on supervisory staff, implements and tools. The chief method employed in this work is to arrest the flow of water by means of staggered trenches on the contour, having adequate banks on their lower sides. These trenches retain moisture and are used for starting grasses which in time cover the eroded area. Cultivation and grazing are prohibited on the area until such time as the

grass cover introduced has had the effect of re-making a fertile surface soil. This work is chiefly done in areas, whether they are old grazing or old arable areas, which have been destroyed by the community as a whole. In most cases the land was used alternatively for grazing and cultivation. The grass chiefly used is *Cynodon* sp., but successful trials were made with Kikuyu grass.

With the object of obtaining a better distribution of the stock population in some comparatively waterless areas and of providing a more adequate water supply for the human population, a number of new water-holding dams were constructed by voluntary labour.

From the time when a European development officer, paid for by the Local Native Council, was stationed in Ugenya, Central Kavirondo district, it was possible to undertake more extensive reclamations there. His work was mainly confined to the rejuvenation of grassland and of areas which had remained under unskilled cultivation too long, to the making of dams, and to the improvement of water supplies. In the South Kavirondo district, nine M'fang'ano Islanders were employed in addition to the regular native staff. On M'fang'ano Island soil control has been practised for generations, and the islanders are skilled in this work.

Soil Conservation in the Central Province

The standard resolution on soil control for Local Native Councils was brought up before all seven Local Native Councils in this Province. The resolution was eventually passed by all Local Native Councils except those of the Fort Hall and Kiambu districts. These two districts still hold out against the resolution, the terms of which are:—

A

(Section 23 (1) (c) of Ordinance No. II of 1937)

"The Use of Land"

"1. That for the purpose of preventing soil erosion—

- "(a) on steeply sloping land, no person shall, except with the permission of the Headman—
 - (i) for the purpose of cultivating any land cut down or destroy in any manner whatsoever, any tree, bush or other vegetation growing therein; or
 - (ii) depasture cattle, sheep or goats;
- (b) no person shall, except with the permission of the Headman, within ten yards of the bank of any river or stream cultivate the land, or depasture cattle, sheep or goats, or burn, cut down or destroy in any manner whatsoever any tree, bush or other vegetation;

- (c) no person shall set fire to any live grass, bush, undergrowth or forest.

2. That for the purpose of preventing soil erosion the occupier of any steeply sloping land used or intended to be used for cultivation shall, if directed by the Headman, carry out such measures with regard to terracing, strip-cropping, contour ploughing, stone walling, banking, lining with plant residues, planting and maintenance of grass or plants in strips, or live wash-stops, as such Headman may, on the advice of an agricultural officer, direct.

3. That, in order to prevent wash being caused to land by water entering it from above, every person occupying and cultivating steeply sloping land shall leave at the upper boundary of such land, and at subsequent intervals of not more than twenty-five feet of such land parallel or such upper boundary, a strip of bush, trees, grass, or crops of such a width as the Headman may, on the advice of an agricultural officer, direct."

B

(Section 23 (1) (k) of Ordinance No. II of 1937)

"Empowering Headmen to Require the Able-bodied Men to take such measures for dealing with soil erosion as may be necessary."

"That—

- (a) measures dealing with soil erosion are hereby declared to be a minor communal service; and
- (b) for the purpose of preventing soil erosion all able-bodied men shall, on land other than land subject to right-holding or in private occupation, except with the consent of the occupier or right-holder thereof, carry out any of the measures specified in the Schedule hereto, and Headmen are hereby empowered to require such able-bodied men to take any of the said measures.

Schedule

- (a) The prevention of destruction of forest, bush or grass by fire or by any other means;
- (b) the reafforestation or planting with grass of denuded areas;
- (c) the construction and maintenance of dams and water supplies, and the regulation of the use thereof;
- (d) the stopping of gullies and the construction and maintenance of terraces and contour banks."

The Senior Agricultural Officer, Machakos, writes:—

"In spite of all these difficulties, natives are becoming more soil-minded, and are gradually coming to believe that the soil is the greatest heritage they possess. There can be little doubt that the first step in any soil conservation work must be to get the people to farm the land properly. When this has been achieved, mechanical works for the prevention of soil erosion may be considered."

In 1938 a loan of £23,000 was made from the Colonial Development Fund to the Machakos Local Native Council,

and a free grant of £10,000 was also made "for the comprehensive treatment of 100,000 acres . . . in the nature of an experiment and a practical demonstration in that area (Matungulu-Kangundo, Machakos Reserve), to ascertain what can be done to save these Reserves in Kenya from absolute destruction." A plan was drawn up for erosion control demonstrations in various parts of the Reserve.

In the Machakos district a staff of Europeans was employed under the Soil Engineer, who was stationed there, on anti-erosion work, which included mechanical and hand terracing, contour ploughing and preventing cultivation and grazing near gullies and rivers. In all, some 360 acres of land were terraced.

An attempt at compulsory destocking was made, but was abandoned towards the end of the year, and the policy was adopted of encouraging enclosure of individual holdings.

The predominant cause of erosion in Machakos is overstocking and large continuous areas present a denuded appearance in varying degree due to this cause. A minor cause is cultivation without manure or anti-erosion measures.

The position can only be improved in the first place by controlling the grazing, and by adopting a rotational system of pastures with crops, thereby providing manure, and protecting the cultivated lands by simple anti-erosion measures. The land in Machakos is individually owned. The first step therefore is for each individual to fence the outer boundaries of his land, and to assume responsibility for the control of grazing on his own holding. For this purpose, free issue of sisal suckers for boundary marking was begun towards the end of the year. When thorn bush is heavy and detrimental to a good grass cover, it is cut and used for boundary marking. The final aim is the compact holding on which mixed farming is practised, and which must be of sufficient size to enable the holder to obtain a reasonable living. For every acre and a half under cultivation, there should be sufficient grazing available on the holding for the support of one head of cattle. Later on, when fertility has increased and natives have learned to bed down their animals at night and to stall-feed them, one beast should provide sufficient manure for the upkeep of fertility on one acre of arable land.

Each individual is persuaded to cultivate flat land, but where this is impracticable contour lines of live wash-stops are made, spaced at three-foot vertical intervals. In certain areas

it may be possible to terrace. Each cultivator is persuaded to manure his land. This, together with the measures taken for the prevention of erosion, should prevent the denudation of fresh land from shifting cultivation.

The cultivation of valley bottoms where storm waters are discharged is prevented, and such bottoms will be demarcated and planted with Star grass. Cultivation and grazing is to be prohibited within ten yards of the banks of gullies and rivers. The adequate supply of water to all areas is under investigation in collaboration with the Hydrographic Section of the Public Works Department. Bare eroded areas are being closed to stock of all kinds and are being put under grass. Communal grazing areas, left over after fencing is completed, will be under the control of the Headman, and a system of rotational grazing will be introduced together with the limitation of the number of stock. Wattle planting on sloping land will be carried out in strips. Sisal and tree nurseries will be maintained.

Landless stockowners are believed to be the chief cause of the wholesale destruction of the grass cover. Owners of uneconomic small parcels of land are being persuaded to sell out to neighbours and apply for holdings in the Makueni area, which is at present very sparsely populated, but which, when cleared of bush, tsetse-fly and wild animals, will be a good agricultural area.

Other Districts of the Central Province

In other districts of this Province, where land is not individually owned, the main drive was for simple methods of soil conservation, such as manuring and planting live wash-stops. Several demonstration areas were established. Gangs of levellers are employed in each district, who peg out lines on the contour at three-foot vertical drops. These contour lines are planted with double rows of live wash-stops, and natives are instructed to lay trash and stover against these lines after harvest. In this way banks are formed and soil movement is stopped. In all, 12,659 acres were protected in 1938 with live wash-stops in this way, the plants used being species of *Sporobolus*, *Panicum*, *Hyparrhenia*, *Themeda*, *Coleus*, *Salvia*, *Brachiaria*, and Napier grass. Large numbers of natives were induced to practice mixed farming methods, and grass-fire control progressed. Attempts were made at re-seeding and re-planting bare grazing areas.

In the Meru district two Europeans were engaged by the Local Native Council for work under the agricultural officer. In addition to live wash-stops planting, these officers supervise all matters having a bearing on soil conservation, such as grazing control, grass and bush fire control, gully blocking and reafforestation.

*Soil Conservation and Maintenance of Fertility in the
Coast Province*

The most important development in this Province was the inauguration of the Gede Settlement Scheme near Malindi. By the end of the year 130 holdings had been occupied. The object of the scheme is to establish cultivation on holdings with permanency of tenure, to obviate subsequent fragmentation, and to introduce mixed farming principles into the husbandry system. Seeds and plants were issued to settlers, and a start was made on improving the water supply. Details of the scheme are given under the head "Mixed Farming."

Somewhat similar settlement schemes are proposed for the Mrima-Kikoneni area of the Digo district and for Taveta in the Teita district.

The difficulties which are in the way of such schemes are not insuperable. Their value in the solution of the problem of soil conservation is considerable, and they will have an additional use in that they will serve as controlled areas in which new crops can be issued and in which new methods can be introduced.

No more casual immigration will be permitted; lands added to the native reserves under recommendations of the Carter Commission will be settled on an organized basis.

The cultivation of the pigeon-pea was further encouraged along the Digo coast. A rotation, including the pigeon-pea as a resting crop, is now in general use in school gardens, and has been introduced to some extent in certain locations of North Kilifi and Malindi, where it has been combined with the issue of seed of improved crop varieties.

In 1938 standard resolutions were passed by the Coast Province Local Native Councils. The laying of crop refuse along contour lines was encouraged and progress in that direction was made in certain areas. Local Native Councils and individual cultivators are showing a greater appreciation of the need for preventing erosion.

Tree-planting continued to make progress, and the value of windbreaks was constantly stressed.

In the Teita district the use of live wash-stops increased and reafforestation continued to make progress with the encouragement of the Administration. An assistant agricultural officer will be stationed in the Teita district in 1939.

Investigation was made into the optimum period for land to be under a resting crop. There is evidence to show that one year under a resting crop will give a marked stimulus to the first crop grown after it, but that the effect soon wears off. The new trials allow for one, two and three years under a resting crop.

MIXED FARMING

The Nyanza Province

The extension of mixed farming is based on the experience gained from the demonstration smallholdings, of which there are seven in the Province, four at the Department's station at Bukura (North Kavirondo), one at the Local Native Council seed farm at Maseno (Central Kavirondo), one at the Government African School, Kisii (South Kavirondo), and one at the Government African School, Kabianga (South Lumbwa). At Bukura the agricultural apprentices manage or assist in the running of the holdings in order to gain practical experience of mixed farming and an understanding of the value of the system in their agriculture.

On the Bukura holdings investigation of the under-mentioned matters is proceeding:—

- (a) Crop rotation, embracing food and cash crops.
- (b) Indigenous and exotic grasses suitable for pasture, paddocking and grazing rotation.
- (c) Animal husbandry.
- (d) Maintenance of soil fertility.
- (e) Suitable buildings.
- (f) Accounts and costing.

In the year under review much was done to further in the reserves of this Province certain methods of husbandry which will assist in the gradual development of the crofting system. The use of manure and compost and the acreage under planted trees are increasing every year. The value of planted trees for use on the homestead is now becoming known through the efforts of the Department, which has distributed many hundreds of thousands of trees. The soil control drive is making the people more conscious of their duty towards the land they work.

Propaganda for the making and greater use of compost was lessened and more attention was paid to the proper utilization of the large quantity of *boma* manure which lies idle in the villages. Until people can be persuaded to apply this valuable material to the land, little headway will be made with compost-making. The more enlightened cultivators already appreciate the value of manurial applications to the soil, and it can be said that in the Maragoli region (North Kavirondo), where population is dense and little land is available for each family, practically the whole of the manure available is now used on the land.

Attention was particularly directed, naturally, to the highly populated areas of the Province. In these areas, in some of which the population is as high as 1,000 per square mile, the pressure on the land is becoming more and more acute, and it is asking too much of the soil to support such a population. The one solution is to induce people to settle in the more thinly populated areas which are, relatively speaking, plentiful.

Small migrations from Maragoli, one of the most thickly populated areas, to the Kisii highlands have occurred, but the migration has been too late to be of any assistance to the well-being of the land itself without a few years of reclamation measures. There appears, in fact, to be a general decline in soil fertility in the closely populated areas. The situation could be ameliorated by the better use of the cattle. The cattle, however, are poor and the present grazing is inadequate, making the supplementary feeding of cattle absolutely necessary. Thus, as there can be no increase in crop acreage in these areas, increased production of food crops—in fact, the maintenance of present production—can only be attained through better husbandry methods. After many years of propaganda and demonstration it is pleasing to record that a real beginning has now been made with the smallholding system, and that in the last four months of 1938 about twenty-eight people in Maragoli and Tiriki made efforts to establish themselves on better holdings. This is probably the most important advance made in the year. On the assumption that the African is fonder of his cattle than of his hoe, the fencing and improvement of grazing was made the first step towards improvement. A considerable number of paddocks with post and rail fences or hedges with *Euphorbia* sp. have been made, and one or two cultivators have built cattle-sheds and have

started to make good farmyard manure. No fodder crops are yet grown specially for the supplementary feeding of cattle, but it is not uncommon for maize thinnings, unproductive maize plants, and Napier grass from soil control banks to be fed. More progressive farmers now purchase rock-salt for their cattle. Cases of grazing improvement by weeding and the planting of better grasses such as Kikuyu grass (*Pennisetum clandestinum*) are known. This type of development is particularly necessary in the South Lumbwa district, where the present extensive bush is nothing more than goat feed.

There is a tendency for too much to be expected from improved grazing, but now that a real start has been made it is hoped that development will be rapid. It is interesting to note from the sociological point of view that people now realize that paddocking their stock releases children for school.

The Central Province

As the result of continuous propaganda and demonstration, the practice of farming crops and stock together is increasing rapidly, and even in fragmented holdings it is quite common to see women going to work in the mornings with a bag of manure on their backs.

In this Province it can be said that mixed farming is now an established practice with many, and that the time is not far distant when it will be the rule rather than the exception.

The Coast Province

The most important development in the direction of mixed farming in this Province in 1938 was the inauguration of the settlement scheme at Gede, near Malindi.

That such a scheme to deal with the problem created by native cultivation in the coastal area was under consideration by Government was referred to in last year's Report. Approval of the scheme was received in time for a start to be made in the long rains, and a block of some 10,000 acres of Crown land at Gede was set aside for the purpose. Settlers are being put on holdings of 11 to 12 acres, and are being given security of tenure subject to certain conditions. These provide against subsequent fragmentation or mortgaging of the holding and insist on suitable methods being adopted to conserve soil fertility.

In the long rains fifty-one settlers began cultivating their holdings, though in a number of cases only a small area could

be cleared. By the end of the year 130 holdings had been given out, and it is expected that 150 will be taken up before next long rains. All Crown land in the neighbourhood has been cleared of squatter cultivation. Settlers are expected to live on their holdings, but this cannot be done until preliminary clearing has been finished.

Some natural suspicions of Government's intentions were entertained at first, but confidence is being established and the earlier settlers appear to be quite contented.

To enable settlement on this scale, much development work with limited funds has been necessary. A motor road from the main Malindi road to the sea has been cleared and lines of demarcation totalling many miles have been cut. Permanent boundary pegs are being made and a preliminary search for further water supplies has begun. A hydrographic engineer is visiting the area in the New Year to go fully into the question of water supplies for the future, and there is reason to believe adequate quantities will be found to serve the needs of the settlement.

A start has been made with the development of a model holding and an area set apart as a social and trade centre. In order to ensure adequate supervision and also to establish close relations with the settlers, an assistant agricultural officer has been stationed on the settlement area near Watumu.

A condition of the scheme is that in due course certain old settlements shall be brought into line and controlled in a similar manner.

In Digo district a somewhat similar scheme is under consideration for the Mrima-Kikoneni area. This, the most fertile part of Digo district, is at present sparsely populated owing to lack of communications and inadequate water supplies. Steps to remedy both these defects are expected to be taken in 1939, and subsequent developments of the area it is proposed to control on similar lines to Gede. The satisfactory development of this area should relieve some of the congestion at present experienced in the Digo coastal belt and enable soil rejuvenation methods to be adopted there with greater prospects of success than hitherto.

A third area in which a scheme is contemplated is at Taveta, in Teita district. Its desirability has been accepted, and the posting of an officer to Teita in 1939 will permit of the matter being adequately considered.

FAMINE PREVENTION

In 1938 weather conditions were in some parts unfavourable to the production of good crops; unseasonable drought conditions and uneven rainfall distribution occurred in the Nyanza and Central Provinces, and heavy rains and flooding occurred in the Coast Province. Nevertheless, food crop harvests were adequate and shortage only occurred in a very few localities, and was met by supplies from neighbouring districts.

The work of introducing and multiplying early maturing disease-resistant and heavy-yielding strains of the principal food crops has been carried on for a number of years. Some of the strains introduced, notably Dobbs and Kano sorghums, Bukura eleusine millet, Muratha maize, pigeon-peas and tepary beans, are now in general cultivation, and undoubtedly play an important part already in lessening the risk of food shortage through uneven rainfall distribution, as in 1938.

In 1938, in the Nyanza, Central and Rift Valley Provinces, and the Turkana extra-provincial district, locusts menaced food supplies. On the whole, as far as 1938 was concerned, little crop damage was done in native areas, but even if cereals and legumes and certain cash-producing crops such as cotton suffered badly, real famine was adequately insured against by the large acreage which was under cassava and sweet potatoes, especially in the Nyanza Province. These root crops are not attacked by locusts. The years 1937 and 1938 saw a considerable increase in these crops, due to this Department's propaganda and persuasion. In this connexion it may also be recorded here that a solution of what is perhaps the most serious problem connected with cassava-growing—mosaic disease—is almost in sight as a result of the work on mosaic-resistant strains which is being carried out at the Kibarani Experiment Station in the Coast Province.

COTTON

The number of ginneries in the Colony is now as follows: Nyanza Province, 7; Central Province, 4; Coast Province, 4. This includes the new ginnery at Nziu, Central Province. The crop suffered a setback in 1938. Uneven rainfall distribution reduced considerably the yield in all three cotton-growing Provinces. Other factors which reduced the crop were attack by jassid in the Coast Province and low prices everywhere.

In surveying this crop in the Nyanza Province it must first be recalled that the 1937-38 season closed with the price for "A" quality seed cotton at 8 cents per lb, and for "B"

quality seed cotton at only $1\frac{1}{2}$ cents per lb. The latter being so low, growers considered that the cost of picking and transport were out of proportion, and little was sold. The total crop was 22,553,057 lb., 4.8 per cent less than the 1936-37 record crop. The acreage of the early crop, which is grown in the low, lake-shore areas from Port Sio, in the north near the Uganda border, to Muhoro Bay in the south on the Tanganyika border, was very considerably reduced owing to lack of rain from May to August. The majority of the cotton which was planted in that early area was planted late, and consequently failed to yield well.

It has been usual in the past to get sufficient rain in December to cause a second flush, but in 1938 this did not occur, and consequently yields were even further reduced.

On top of these adverse weather conditions distrust in the crop was felt by many growers owing to the low price; the acreage sown was lower than in 1937, which was a record year, in all of the comparatively new cotton-growing areas; that is, in all areas except North Kavirondo, where the crop is an old and really established one. In North Kavirondo, which is the main late-sowing area, the acreage was slightly greater than in 1937, but the yield there as well was considerably lower than in 1937.

Weather was ideal at sowing time, but rain continued into October, causing the crop to fail to produce the typical tap-root, which would have served it well in the unusually dry weather which occurred in this area in November and December. Flower and boll shedding were very severe in all areas.

The selling season opened on 5th December with "A" quality seed cotton at 9 cents per lb. This price fell later to 8 cents per lb., and remained at that price until the close of the season.

An interesting change has occurred in most of the North Kavirondo area. Many growers now look on cotton as a catch crop to be grown before or after eleusine millet, which is one of their staple food crops. Before the cotton harvest is over the soil between the cotton plants is dug and, when sufficient rain has fallen, the millet is sown. The young millet crop is sheltered by the old cotton plants, and when it is a few inches high the cotton has all been picked and the cotton plants have been removed.

The 1938-39 crop amounted to 8,619 bales of 400 lb. each.

In the Central Province cotton-growing is confined to areas under 4,200 feet, where the population is sparse and where there is no other suitable cash crop available. In the cotton zones of the Kitui and Machakos districts sowing is done in October and November, while in the cotton zones of the Fort Hall, Embu and Meru districts the crop is sown in April.

The 1937-38 crop in Thika and Machakos harvested in September, 1938, was:—

	“A” Quality		“B” Quality	
	<i>Lb.</i>	<i>Per cent</i>	<i>Lb.</i>	<i>Per cent</i>
Kitui	335,840	61	206,797	38
Machakos	168,570	66	87,718	34
	504,418	—	294,515	—

Total of both grades—798,925 lb.

The crop of the previous season was:—

Kitui	1,179,377 lb.
Machakos	162,204 lb.

When growers knew that the price for “A” quality was 7 cents per lb., as compared with a fluctuating price of 9 to 10 cents per lb. in the previous year, interest waned and great difficulty was experienced in getting the crop cultivated, or even picked.

It has been shown that cotton does not do well on the red soils in the dry areas, so that in the 1938-39 season an effort was made to limit planting to the darker soils. Each *shamba* was protected as far as possible with contour lines of live wash-stops, trash or stones. The rains came late, so that planting was not completed until early in December. A trial extension of the cotton area in Kitui was made in the more arid region of Mumoni, where famines are of frequent occurrence and the natives have no cash crop. A total of 7,580 acres was planted in Kitui and 2,500 acres in Machakos. The crop made rapid growth in December, and, provided some showers are obtained in the early part of 1939, the crop will be good. Much of the crop is inter-planted with gram and pigeon-peas. A small ginnery was opened in July at Nziu to handle the crop from Machakos district.

Fort Hall, Embu and Meru.—As already mentioned, planting is carried out in April and harvesting takes place early in the following year. Yields, especially in Embu, have been disappointing, and natives have not taken to the crop. The situation has been aggravated by poor seasons and by the fall in price immediately after the crop had been introduced. Undoubtedly the best average yields are obtained in Meru district. The following are the returns obtained from the 1937–38 crop in the three districts:—

	Acreage		“A” Quality	“B” Quality
	Prepared	Matured		
			Lb.	Lb.
Embu	3,000	2,000	59,832	62,316
Fort Hall	1,380	800	22,400	28,556
Meru	2,000	1,800	167,717	83,675

The total output of cotton from the Province in 1938 was 1,019 bales. It was decided to reduce the acreage planted in 1938–39 in these areas, so that more attention could be given to the better cultivation of individual plots. Severe drought conditions were experienced, however, in the cotton areas from June to October, and it is feared yields will again be poor. Experimental work is under way, details of which will be provided later in this report.

In the Coast Province also the low price of cotton in 1937, particularly that of second grade, caused considerable dissatisfaction amongst growers. In the main cotton areas, which are found in the Kilifi–Malindi coastal belt, the feeling was very strong amongst Arab and Swahili growers. As a result, the acreage planted fell heavily, and many growers, attracted by the high prices of simsim which ruled in the previous year, decided to plant that crop instead. In Digo district the acreage was maintained, and in the reserves of Malindi and Kilifi it was increased. On the Tana River, however, planting conditions were extremely adverse, and only a small area could be planted. Dissatisfaction was also present at Taveta, and resulted in a sharp drop in acreage and a considerable diminution in interest during the growing season.

In spite of the wet season, cotton grew well, and appeared healthy until August, when a heavy infestation of jassid

became general. Boll shedding followed on a large scale, and continued after the jassid attack had diminished and new growth had been made. In the worst cases from two-thirds to three-quarters of the crop was shed and bolls formed late in the season were generally diseased. Yields were abnormally low in consequence. This, together with the drop in acreage referred to above, has resulted in the smallest crop for a number of years and the poorest return to growers since 1930.

Investigations into the cause of this boll-shedding were started at once, and are discussed at some length in the report on investigational work. Jassid was directly responsible for a part of it, but much would appear to be due to disease, with possibly jassid as a contributing factor. Jassid, in fact, must now be regarded as a major pest on the coast. That such a state of affairs might occur was foreseen several years ago, and varieties resistant to jassid elsewhere have been the main types introduced for trial. It is disappointing to have to report, therefore, that even the best of these have suffered severely this year. Though these are better than the local type, the search for greater resistance will need to be continued vigorously.

Prices continued low, with "A" grade seed cotton selling at ginneries for 8 to 9 cents per lb. and "B" grade almost unsaleable with a minimum price of 1 cent per lb. at ginneries. Fortunately, stainers were remarkably few, and once again the proportion of "A" grade cotton was high. Nevertheless, the low price of "B" grade is probably a more serious cause of dissatisfaction than that of "A" grade.

Cotton production in the last nine years is given in the table on page 19, Part I. Investigational work in cultural methods continues in all three Provinces, and is described later in this part of the report.

WATTLE

In the Central Province fresh plantings were made in the Machakos, Embu and Meru districts, amounting in all to approximately 6,000 acres. In the other wattle areas of this Province some 100,000 acres are established, and no increase in this acreage is being made. The policy in these established wattle-producing areas is to obtain for the grower better returns per acre by instructing him in better methods of thinning and postponing cutting until maturity. Plantations which have been improperly thinned in the past are being completely felled when seven years old and properly re-established.

Owing to lack of demand for dry bark overseas, the open buying season was restricted to just over five months. This, together with a tightening of inspection, resulted in a drop in production for the year to 11,649 tons of dry bark and 2,500 tons of green bark. The figures of wattle bark marketed in the past three years were as under:—

1936		1937		1938	
Dry Bark	Green Bark	Dry Bark	Green Bark	Dry Bark	Green Bark
<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
		16,025	5,202	11,649	2,500
20,285		21,227		14,149	

In the Nyanza Province the wattle acreage was increased in 1938 by approximately 9,000 acres. The increase in acreage in Nandi and Lumbwa was disappointing. Of the total of 9,000 acres, 5,500 were planted in South Kavirondo, and development of the young trees there was good. In Lumbwa wattle is a great aid to the reafforestation of the many bare hillsides. Propaganda and demonstration aim at introducing better plantations. Thinning technique was continued, but lack of skill in the art of thinning is still evident.

The value of this crop as a means of afforesting uncultivable bare slopes, as a soil rejuvenator and as a timber and fuel producer is now thoroughly recognized, and the policy is to plant wattle in places which will be benefited by it, not to put land suitable for arable cultivation under it.

MAIZE

Maize-growing increased in both 1936 and 1937 in the Nyanza Province and in 1938 it increased yet again. Owing in the main to the high price in 1937 and in the early months of 1938, the long rains sowing in the main maize-growing districts created a record for this Province. Weather conditions were, generally speaking, favourable, and an excellent crop was marketed from August to November. By that time the price had weakened, but did not fall below Sh. 5 to Sh. 6 per bag of 200 lb. This delayed selling. Notwithstanding this, the short rains sowings were large also, but dry weather from mid-October onwards caused the yield to be light and the growing quality to be scarcely up to average.

In the areas where maize is chiefly grown for export in this Province, Flat White is the variety used, and it is found

to be satisfactory under the local conditions. In other and warmer areas, with shorter growing seasons, where maize is grown for local consumption, the cultivation of the earlier maturing Muratha selection from Flat White is increasing, and it is displacing the old coloured types.

An increase in the use of small gristing mills throughout this Province is causing an increase in the amount of maize flour used in the daily ration and a decrease in the amount of millet used.

The increase in maize production in the native reserves of the South Lumbwa district is noteworthy; this is a recent development, and consequently grain quality is scarcely up to export standard yet. At present, the local market absorbs the bulk of the crop produced.

Maize sales accounted for in Nyanza Province:—

1936		1937		1938	
Bags 200 lb.	Value	Bags 200 lb.	Value	Bags 200 lb.	Value
150,970	£ 48,810	246,767	£ 91,026	313,758	£ 77,895

In the Central Province the quality of this crop continues to improve in all districts, and a record of 424,407 bags passed the local inspection centres for sale during the year. Considerable quantities of maize are sold direct to the neighbouring European-owned plantations which escape inspection and do not appear, therefore, in the count shown above. The figures of maize passing inspection during the last three years are as follows:—

1936	1937	1938
180,404	105,200	424,407

This very sharp rise in production is accounted for by the excellent yields obtained from the 1937-38 short rains plantings, by the great increase in the use of manure, by the use of better seed, by better cultivation and by new production of maize in areas far from rail. Most of the increase is indirectly attributable to inspection and organized marketing of produce.

which has resulted in a higher price to the producer with encouragement to obtain better yields from his land. Large quantities of the crops were exported in order to avoid a glut on the local market. Prices have ranged from Sh. 5 to Sh. 7 per bag of 200 lb. at Thika.

Native-grown maize was exported overseas in 1936 for the first time since 1929, and at that time it was of grades K7 (mixed) and K8 (under-grade). In 1936 native-grown maize exported overseas was of much better grade, 38.13 per cent of it being of grades K2, K3, K2 S.W., and K3 S.W.

In 1937, owing to internal shortage, hardly any native-grown maize was exported overseas, but in the year under review overseas export was resumed at the end of the year.

In the Coast Province, maize cleaning was commenced in Malindi. The success of the scheme is now assured and the quality of maize from that area has improved markedly. A delay has occurred in the distribution of Durum maize, the type which is thought to be best suited to conditions in this Province, because fresh seed, imported in 1938, was found not to be of a fixed strain.

OIL SEEDS

The groundnut is a most useful crop in the Nyanza Province as a soil improver, food, oil and cash crop. Despite the fact that large areas of this Province are suitable for its cultivation, it is so far only popular in the lower areas of South Kavirondo and in a small part of Central Kavirondo. In North Kavirondo it is grown to a very small extent only. The South Lumbwa Reserve is not suited to its cultivation.

The harvest in all areas was considerably lower than in the previous year. This is partly explained by the fact that a greater proportion of the crop was consumed locally on account of the lowness of the price in 1938.

GROUNDNUTS—TOTAL PRODUCTION IN NYANZA PROVINCE

1936		1937		1938	
Tons	Value to Growers	Tons	Value to Growers	Tons	Value to Growers
	£		£		£
1,620	23,330	3,755	38,478	1,575	13,182

The only other oil seed, apart from cotton seed which is a by-product, grown to any extent in Kenya is sesame seed, and it is only grown in the Nyanza Province and Coast Province. In the Nyanza Province, where the yellow type is chiefly grown, it is grown as a cash crop and in some parts of South Kavirondo it is the chief source of revenue. The first of the 1937-38 crop in North Kavirondo to come on the market was weather damaged in the drying racks and had to be used by the local oil-expressing mills. The remainder of the North Kavirondo crop and the crop from other areas was in demand for export as "Kisumu Yellow".

The 1938-39 crop was late sown and failed in most areas because of dry weather at the end of the year.

The quality of Nyanza Province sesame seed is very good and bagging is efficient. Consequently, the locally grown crop is normally exported and local oil-expressing mills use mainly inferior seed from outside sources.

SESAME—PRODUCTION IN NYANZA PROVINCE

1937		1938	
Tons	Value	Tons	Value
2,938	£ 32,318	1,575	£ 13,182

The low price of cotton caused many growers in the coastal belt of the Coast Province to turn their attention to sesame, with the result that there was a large increase in the acreage under sesame in this Province. The harvest was not good and the price, by the time the selling season had arrived, had dropped sharply from its previous level. Consequently, at the end of 1938, there were indications of a return to cotton growing in 1939.

PULSES

In the Nyanza Province, beans, green gram and cowpeas are important food crops. The first two provide a small surplus for sale. As cash crops they are not of major importance, but trade in them is increasing slowly. The long rains bean crop is regarded as a food crop, and any surplus which is sold is obtained from the short rains crop. In this Province a premium of 50 cents per bag is generally offered for Rose Coco or Canadian Wonder varieties, and some progress was made in 1938 in persuading growers to segregate these higher

yielding types from their stocks of mixed seeds. A difficulty is created because local consumers (gold miners, etc.) are prepared to pay a fairly good price for mixed samples. The Kisumu price was about Sh. 9/50 per bag early in the year and Sh. 7/50 per bag towards the end of the year. Some 8,136 bags were sold from the three Kavirondo districts, their value to the producer being about £3,353.

In the Central Province, Rose Coco, Canadian Wonder and Boston beans are the varieties mainly exported, and a considerable market for them has been built up in recent years. To avoid flooding the market with any one variety at one time, they are grown in separate areas. Both the short and long rains crops yielded well. Painted Lady beans, *Dolichos lablab* (Nyati), pigeon-peas, field peas, Victoria peas and gram have a limited local demand in this Province, but the export of pigeon-peas to East African ports is increasing. In order to improve the diet of dwellers in lower areas and at the same time to satisfy the local demand, larger areas are now being put under gram and pigeon peas.

In the Nyanza Province there was a slight increase in the production of green gram in 1938. Some 5,634 bags of it were sold, representing a cash return to the growers of about £4,632, as compared with 3,130 bags valued at £3,231 in 1937.

Efforts to make growers in Nyanza Province interested in peas continued and to this end issues of Victoria peas for seeding were again made in 1938. Little headway has so far been made, however, with increasing the cultivation of peas. One reason for this is that there is a small local demand and growers sell their whole crop locally and save no seed.

In the Central Province in 1938, 82,457 bags of pulses of all kinds passed through the inspection centres. This figure compares with 32,858 bags in 1936 and 40,896 bags in 1937, an increase of over 100 per cent in twelve months.

In the Coast Province further issues of tepary beans, New Era cowpeas and selected strains of pigeon-peas were made in 1938. These are the food legumes which are chiefly being encouraged in this Province.

RICE

As the result of tests made in 1937 with the recently introduced variety Peshawari in the Coast Province, it was decided that it was possible in 1938 to extend the cultivation of rice in rain-filled swamps in that Province. Accordingly,

issues of that rice were made in Digo and South Kilifi, and the acreage planted, especially in South Kilifi, showed a sharp rise. An issue of seed of Peshawari was also made at Kanga, in the irrigated area, where the acreage, which had decreased, was restored to normal. Excessive rainfall, causing heavy flooding, seriously damaged the crop everywhere in the Coast Province. In the irrigated rice-growing area at Vanga all varieties suffered severely, and considerable loss also occurred in the rain-filled swamp rice-growing areas, especially in Digo. In spite of this, growers were satisfied with Peshawari on account of its early maturing habit and good price. In these areas Peshawari was fetching Sh. 19 per bag, while local varieties only fetched Sh. 12.

One drawback to Peshawari became evident this season at Vanga, namely its liability to excessive breaking. A new variety, Basmati, appears to be superior in this respect, whilst having the good qualities of Peshawari.

The cultivation of rice in the Nyanza Province made satisfactory progress in 1938; the number of growers increased in most of the rice-growing districts. Sales of rice were much lower than in the previous year, but that is only an indication of the growing popularity of rice as an additional food. If there had been no rice in the Kano in 1938 there would have been a serious food shortage owing to the partial failure of the millets.

The preparation of land for the early 1938 crop in North Kavirondo, which is nearly all grown under semi-upland conditions, was hindered by excessive water and the time spent by many growers on locust-hopper beating at that time. An endeavour was again made to introduce rice-growing in the north-west of Central Kavirondo, but the people there have not yet taken to it.

In order to provide a better water supply in a very dry, flat area of Nyakatch location, Central Kavirondo district, the assistant agricultural officer of that district surveyed a canal nearly eighteen miles in length. The canal was made by about 2,000 voluntary daily workers in roughly five weeks. This canal now carries an ample and continuous supply of water from the Nguo River to Kusa Port. The area watered is admirably suited to rice-growing. A good proportion of the land adjoining the canal was divided into ranges of one-acre irrigated fields, which were in turn divided into quarter-acre plots for individual rice-growers. By the end of 1938 a large part of this area was under flourishing rice.

The cash value of 1938 sales in Nyanza Province was £559.

QUANTITIES OF RICE SOLD IN NYANZA PROVINCE

DISTRICT	1935	1936	1937	1938
	Tons	Tons	Tons	Tons
North Kavirondo ..	5	11	102	42
Central Kavirondo ..	41	166	409	60
TOTAL ..	46	177	511	102

Very little rice is grown outside the Coast and Nyanza Provinces. In the Central Province the crop is still in the experimental stage, and very few localities are suitable for its growth. A little was again grown in the Meru district. Some rice is grown on the upper reaches of the River Tana, near Garissa, in the Northern Frontier extra-provincial district, and rice is being tried, under irrigation, on a very small scale in the West Suk district.

COFFEE

The growing of both Arabica and Robusta coffee in native areas is only allowed in gazetted localities, which are selected for their suitability for the one type or the other.

Arabica Coffee

Central Province—Experimental

Plantings continue to be confined to the Githungururu location of the Embu district and to the Kaithi and Chogoria locations of the Meru district. The total acreage at the end of 1938 was 64 acres. In 1938 the Kaithi crop was auctioned as *buni* and the Githungururu and Chogoria crops were sold as parchment. Trees on the whole were very well looked after, nearly all of the plantations being box-terraced, manured and thatched. Twenty-two new growers planted 100 trees each.

Mealy bug and Antestia did some damage in Chogoria, which necessitated grease-banding and dusting with pyrethrum powder. These pests are now under control in this location.

SALES OR DELIVERIES AT FACTORY IN 1938

	Cherry	Parchment	Buni	Value
	Lb.	Lb.	Lb.	
Githungururu ..	49,521	—	—	—
Chogoria ..	—	3,825	—	—
Kaithi ..	—	—	3,378	—

Nyanza Province

Growing is confined to the South Kavirondo. The acreage in that district was increased to 95.88 acres by the end of the year, representing 166 growers. Of these, 17.48 acres and 50 growers were new in 1934. Apart from some Gethin's seed planted in the long rains, the new acreage is all under Kenya Blue Mountain, which is now the accepted variety in South Kavirondo owing to its resistance to coffee-berry disease. The Kent's variety, which has already been attacked by this disease, will in due course be replaced.

Windbreaks of *Tephrosia vogellii* are now used and *Milletia dura* is planted as permanent shade, replacing the temporary *Sesbania* sp. shade.

Box-ridging was introduced in all plantations of three years or over, where food crops are no longer interplanted. Cultural treatment has been well done on the whole.

At the end of 1937 there was one pulping station at Nyaribari; two others, at Bassi and Kitutu, were built and brought into use in 1938. As the number of growers now selling has increased, records of output from these stations in cherry and pulp in bulk were started.

The total sales of parchment from this district to date are 59 cwt., the net return to the growers being £86.

Robusta Coffee

Central Province

The acreage planted in the north-east of the Meru district in 1937 ($23\frac{1}{2}$ acres) was not added to in 1938. All plantations were protected from soil erosion and manuring commenced.

Nyanza Province

The table below shows acreage and number of growers:

DISTRICT	AT END OF 1937		AT END OF 1938	
	Growers	Area	Growers	Area
	Number	Acres	Number	Acres
North Kavirondo ..	55	$27\frac{1}{2}$	55	$27\frac{1}{2}$
Central Kavirondo ..	12	2	28	$5\frac{1}{2}$
South Kavirondo ..	188	47	195	$48\frac{3}{4}$
TOTAL ..	255	$76\frac{1}{2}$	278	$81\frac{3}{4}$

A good supply of seedlings of the Nganda strain was available in all areas at the end of the year for new plantations and supplies in the 1939 long rains. It has been difficult to get growers to shade adequately, but where either living or artificial shade was introduced a marked improvement in growth has occurred. Living banana shade is sometimes used and provides additional food. The 1936 plantings flowered and bore a light crop.

TOBACCO

The Central Province

The introduction of the tobacco crop in this Province has been particularly valuable, in that it is the only crop the tending of which is regarded by custom as the male's duty. In the Embu and Fort Hall districts, the localities at present considered suitable for tobacco-growing are limited, and a large number of growers do not own the land on which they are growing tobacco. Great care will consequently have to be taken to ensure that soil fertility is preserved and proper crop rotation is practised. Experiments on the maintenance of fertility in this area and on the control of tobacco diseases and pests will be undertaken in 1939.

The successful results obtained from the experimental growing of tobacco leaf for flue curing at Sagana in 1936 led to an increased acreage being planted in October, 1937. The picking and curing of this crop commenced in January, 1938, and the result was again successful. The October, 1938, plantings were again increased. The Embu crop to be harvested in 1939 is most promising, and the 1938-39 Fort Hall yields should be better than before.

	Embu	Fort Hall
1936-7 :		
Acreage	7	1½
Total Yield—Green Leaf ..	13,728 lb.	Not recorded
Yield per Acre—Green Leaf ..	807 lb.	Not recorded
1937-8 :		
Acreage	8½	23
Total Yield—Green Leaf ..	52,364 lb.	55,313 lb.
Yield per Acre—Green Leaf ..	6,100 lb.	2,317 lb.
1938-9 :		
Acreage	31½	38½

The average yield of 6,100 lb. of green leaf per acre obtained in Embu in the 1937-38 season is astonishing, and provides a return to the grower of Sh. 242 per acre. In general, in 1937-38, individual plots were a quarter of an acre in size, and the best individual return was Sh. 83; that is, Sh. 332 per acre.

The varieties grown are now limited to Cash and Golden Dollar, and the green leaf is bought by the British-American Tobacco Co., Ltd. There are now nine curing barns and two sorting sheds in use in the Embu-Fort Hall tobacco-growing area.

Trials of flue and fire cured types in the Kitui district in 1937 also proved successful. Consequently, in the March, 1939, rains ten acres for flue curing and fifty acres for fire curing were planted. A flue barn was erected by the British-American Tobacco Co., Ltd., at Kitui Township, and thirteen fire barns were built by the native growers. The crop was reduced by failure of rain at planting time and later. The yields were:—

	<i>lb.</i>
Total yield of fire-cured leaf	28,104
Yield of fire-cured leaf per acre	562
Total yield of green leaf for flue curing	19,085
Yield of green leaf for flue curing, per acre	1,908

The Nyanza Province

In 1938 the tobacco acreage increased in the North and Central Kavirondo districts. In South Kavirondo variety and cultural trials were started and satisfactory samples were sent to the Ndere factory before the end of the year.

The variety grown in this Province is Western Dark Nyasa, but selections from its derivative, Itheme No. 3, are proving more satisfactory than the original strain, and are now being multiplied for issue. In this Province all leaf is fire cured by the grower before sale; no leaf is grown for flue curing. The crop in North Kavirondo suffered very severely from eelworm and to a lesser extent from hail. Temporary grass barns, built by the growers, are used, but two permanent model barns were built in North Kavirondo with Local Native Council funds.

TOBACCO SALES—NYANZA PROVINCE

DISTRICT	1935	1936	1937	1938
	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>
North Kavirondo ..	14,000	19,222	15,555	15,204
Central Kavirondo ..	—	Trials	3,640	10,387
South Kavirondo ..	—	—	Trials	202
TOTAL ..	14,000	19,222	19,195	25,793

The amount received by growers for tobacco leaf sold in 1938 was:—

	<i>Sh.</i>	<i>cts.</i>
North Kavirondo ..	4,072	33
Central Kavirondo ..	2,509	44
South Kavirondo ..	64	41
TOTAL ..	<i>Sh.</i> 6,646	41 or £332 6s.

POTATOES

English potatoes are only grown to any extent by natives in certain parts of the Central Province, but efforts are being made to get natives in the higher parts of the Nyanza Province to grow them. Their cultivation extended rapidly in 1938 in all of the Kikuyu districts, but it is only the Kiambu and South Nyeri districts which produce a surplus for sale. The chief variety grown is Kerr's Pink. In spite of good quality, the price dropped temporarily to as little as Sh. 1 per 180 lb., rising later in the season to Sh. 2/75. More control of marketing and quality of export potatoes is contemplated. The quantity of potatoes inspected and passed as fit for sale in 1938 was 120,013 bags, as compared with 42,000 bags in 1936 and 45,000 bags in 1937.

In the Nyanza Province, in the higher parts of which English potatoes grow well, there is still only a very small production. In spite of repeated free seed issues, the quantity marketed in 1938 was insufficient to meet even the local demand. Most growers tend to oversell their harvests before they even reach the stage of requiring a change in stock seed. To remedy this issues are now being curtailed.

VEGETABLES

As the result of propaganda and instruction, the growing of European vegetables for local consumption is increasing rapidly in all districts of the Central Province and Nyanza Province. In the Kiambu district large quantities are also produced for sale in Nairobi and for export to Uganda.

and the coast. Sales are estimated to exceed £6,000 in value. In the Nyanza Province over 3,500 packets of the more common vegetable seeds were sold to growers by Local Native Councils at wholesale prices. There is as yet no need for organized marketing of vegetables in Nyanza Province; they are hawked round towns and mines. The estimated revenue to vegetable growers in North and Central Kavirondo in 1938 was £5,000. The local demand is not yet fully met. Some growers now produce their own seed.

Vegetable growing in the Teita Hills increased, the produce finding a ready market in Mombasa. Some 182,000 lb. of various kinds were sold in 1938. At present production is unevenly distributed throughout the year, and improvements in marketing are necessary for this industry to grow.

FRUIT

Increasing quantities of various kinds of fruit, mainly from the coastal belt, were sold in Mombasa. The banana acreage in particular has increased in recent years. In 1938 in the Coast Province increases of fruit trees, mainly seedling citrus, were made. These seedlings are in considerable demand.

The high dietetic value of the avocado pear is now generally recognized; it is a most valuable fruit to grow in native areas suited to it. Consequently in 1938 a campaign was started to introduce the avocado into the reserves. This will be continued in future years. The aim is not to have large plantations of the tree but to have one or two trees in every village. This Department obtained an initial supply of seed of good types, which was issued to the reserves in the three main agricultural provinces, and it continues to procure more seed as it becomes available; the supply in East Africa is limited. In time, no doubt, this most valuable addition to the native's ration will become plentiful in Kenya.

CASHEW NUTS

This industry in the Coast Province suffered a setback in the 1937-38 season, when the crop was largely spoilt by heavy rains at flowering time. Quality was consequently inferior, and the factory bought only half as much as in the preceding season, which itself was a poor one. In the 1938-39 season trees flowered well and good crops were set, except in the new South Kilifi plantations, where heavy rains in October stripped flowers off the trees. New plantings were made in the long rains with selected seed issued by the factory. Difficulty is experienced in ensuring the good after-care

of plantations and yields are consequently reduced. Wanton grass fires do much damage. Some growers are so apathetic that they allow nuts to rot on the ground rather than employ labour at a fair price to pick them up.

In 1938 the marketing organization was further improved. The aim is to bring marketing facilities as near to the grower as possible. The price has remained steady.

Experimental plantings near the Gulf shore in the Nyanza Province are not yet in bearing.

COCO-NUTS

The price of copra was very low throughout 1938 and there was little encouragement for growers to increase their output. Nevertheless, planting continued steadily in the Nyika Reserve, and the area under coco-nuts is increasing annually.

KAPOK

Small issues of kapok seedlings were made for the first time in the Coast Province in 1938. A suitable variety having been found, the cultivation of kapok can be developed and marketing facilities will have to be provided later on. (See also under "Improvement of Crop Varieties.")

MILLETS

The production of surplus grain for sale is confined to the Kisii highlands, where some eleusine millet is exported annually to various parts of East Africa. One consignment was sent to Aden in 1938. The average price was about Sh. 8/10 per bag.

ELEUSINE MILLET EXPORTS FROM SOUTH KAVIRONDO VIA KENDU

1937		1938	
Tons	Value to Grower	Tons	Value to Grower
541	£2,677	688	£3,096

TREES

In the Nyanza Province distinct headway was made in tree growing. The number of timber and fruit tree transplants issued from the six main nurseries in the Province was 1,036,500 in 1938. *Eucalyptus saligna* is the most popular tree issued, but is liable to destruction by white ants in the hot, dry areas. The practice of sowing in situ on bare hill-sides *Cassia florida*, *Eucalyptus*, *Citriodera*, etc., is growing.

The steadily increasing number of quick-growing exotic timber trees in this Province will soon stop the drain on indigenous timber for local building, pit-prop and firewood needs. The value of firewood sold from native-owned gum plantations in Maragoli and Tiriki locations of North Kavirondo amounted to some £3,000 in 1938.

WHEAT

There is some production of wheat in Embu, Meru, South Nyeri, and Machakos. The grain is sold through the Kenya Farmers' Association (Co-operative) Ltd.

IMPROVEMENT OF CROP VARIETIES

The prevention of famine occasioned by unusual causes is a special line of work. Improved varieties and strains of crops are sought in local varieties and strains and in introduced plants. Improvement is caused indirectly by the effect of continuous inspection and sorting of produce, by which growers soon learn the good and bad characters of their produce and sort it themselves. The main work on crop improvement in 1938 is summarized below. This work is done mainly on Local Native Council seed farms.

Maize

Trials in 1937 in the Nyanza Province showed that a Kitale strain of flat white was more satisfactory than the other types tried under local conditions. Issues of this strain were continued in 1938, and selection to improve desirable characteristics was carried out. This strain yields better than the old mixed flat white type. In the Central Province, the selection of Muratha maize for heavier yielding, earlier maturing qualities and for resistance to "white blight" was continued. Fresh seed issues are made annually in order to keep up quality.

Millets

Sorghum

The new types which are under selection, and which are being multiplied, are Dobbs, Kano, Katengu, Dwarf Hegari and Sunrise Kaffir. The early varieties, Dobbs and Kano, were bulked at all seed farms in the Nyanza Province. The cultivation of these two varieties is on the increase.

In the Central Province another early maturing and palatable sorghum was discovered growing at Kitui. "Ear to row" selections were made in order to fix the heaviest yielding strain. This sorghum is known as Katengu. Dwarf Hegari

is being issued in the Meru district, as it is better than the local type. Other varieties which are being multiplied for issue are Kano in Machakos and Dwarf Hegari and Sunrise Kaffir in the Embu district.

Dwarf Hegari was the chief cereal to be multiplied and issued in the Coast Province in 1938. While its value is now appreciated by the Giriama, more issues on a large scale will be needed before it gets into general cultivation in this country. In the Duruma country it was issued for the first time in 1938. It appears that it is comparatively free from attack by stalk borer.

Eleusine or Finger Millet

The Bukara strain already frequently met with in cultivation in the Nyanza Province showed a distinct susceptibility to "blast" disease last season. Selection for the improvement of this heavy-yielding early strain is being kept up, and its susceptibility to blast is being investigated. It is a much better millet than the local types at altitudes in the Nyanza Province below 5,000 feet. In South Kavirondo trials were continued of white strains which might be attractive for the export trade.

Bulrush Millet

As the Tanganyika awned type, which is a superior yielder to all local types in the Central Province, is still very mixed in character, "ear to row" selections were made in 1938 in order to isolate and perpetuate the best yielding awned strain.

In the Nyanza Province this type of millet is not appreciated as a food by the natives. The five Bajra types from the Punjab, which were found to be mixed, were selected and sown again in 1938. No improvement was observed, as mixed grain types were again produced by the selected seed.

Rice

Rice is now a popular crop in the Nyanza Province, and is accepted in growing areas as part of the everyday diet. The varieties at present grown are Bungala, Mbuyu and Sindano, Sena and Faiya, the first three having been isolated from the old Mumias mixed type and having been found to correspond with similar varieties grown on the coast. Sena was introduced from Mwanza, and Faiya is also an introduced variety. Some other varieties are still under trial.

In the Coast Province the Peshawari variety from India, of early maturity, is regarded as a distinct advance on local

types, especially for growing under rain-filled swamp conditions. Further issues of it were made in 1938. The drawback to Peshawari is the liability of its straw to break. Another new variety, Basmati, has not this drawback, but has also the good characters of Peshawari. It is hoped to extend the cultivation of Basmati in 1939.

Beans

Selection for resistance to bacterial blight of Boston, Canadian Wonder and Rose Coco beans was carried out at Embu, Fort Hall and Nyeri. In the Nyanza Province the original introductions of the higher yielding types of beans succumbed to bacterial blight. Selection for resistance to bacterial blight of Rose Coco and Canadian Wonder beans has been conducted for some years, with promising results. The seed of selections already multiplied and issued is an improvement on what was in use some years ago.

Soya Beans

This crop is still in the experimental stage in Nyanza Province. Up to 1938, Ototan was the best variety grown, but trials in 1938 showed that Busa may prove to be superior to it. It has a good cream-coloured seed and is a high yielder. It will be multiplied in 1939.

Pigeon Peas

After trials extending over a number of years, in which many varieties were tested, the early variety Bahar No. 16 is thought to be best suited to lake-shore conditions, under which this crop grows best in the Nyanza Province. Natives, however, are still disinterested in the crop. In the Central Province the pigeon pea is an accepted crop in general cultivation. Selection of the white type was done at Machakos in 1938 in order to isolate a good strain. This type is the most readily marketable.

In the Coast Province seed issues of selected New Era cowpeas, an introduced variety, have been made in the last few years. One reason for the issues is that the cowpea is an aid in the work of restoring soil fertility. The demand for seed of this variety exceeds the supply.

Cassava

In both the Coast and Central Provinces the results of trials have shown that the Malindi variety has the highest resistance to mosaic disease of all varieties tried. In the Central Province issues of planting material of it were begun

in 1938 in all the drier areas. In the Coast Province more outside multiplication plots for it were established. Direct issues were also made from central plots. The ultimate object is for every family to have a plot of cassava.

In the Nyanza Province it is widely grown, but no issues of an improved type have yet been made. There are apparently some very mosaic-resistant strains in general cultivation, but despite this a search for really thoroughly resistant variety is being made. To this end a variety trial was started at the Maseno Seed Farm (Central Kavirondo). The

Cowpeas

varieties under trial are five from Amani, the Malindi strain from the coast, and a selection from a local strain which is early and palatable. Other local strains showing good qualities are included, making a total of 35 types under trial.

Sweet Potatoes

It is frequently found that natives themselves select good strains for their particular needs and personal likings. In the Nyanza Province new varieties were tried. Three of them—Russian Leaf, Linslade Leaf, and Yellow Jersey Leaf—showed particular promise, and are being multiplied. A strain known as “Uganda” is the best in general cultivation in Nyanza Province at present.

English Potatoes

Selected seed of Kerr's Pink is issued in bulk annually from seed farms in the South Nyeri, Embu, Meru, and Kiambu districts.

Cotton

Preliminary multiplication prior to issue of the Barberton varieties 998 and 9243 was done at Kibarani in 1938. Issues of seed in a limited area will be made in 1939. About ten tons of seed will be available. The introduction of these varieties is justified on account of their high ginning percentage, but because of their disappointingly low resistance to jassid under coastal conditions their introduction must be regarded as an intermediate stage in the improvement of the cotton crop in the Coast Province. A better resistant type must be found.

Kapok

The variety Bondowoso 5 has been selected for issue in the Coast Province, because it yields regularly and well and has an open habit of growth which makes harvesting easier and more satisfactory.

General

The value of the new drought-resistant early maturing crops receives greater recognition among native cultivators annually. In the Coast Province crop improvement will be aided by the settlement schemes already mentioned in this report. The settlement areas will be large-scale bulking areas of the new crops, anything surplus to growers' requirements being available for purchase and issue to other areas.

PLANT INTRODUCTION

Twenty plant introductions were issued for trial in native areas in 1938. They comprised oil palms, groundnuts, soya beans, tomatoes, guava types, and cover crops. It is as yet too early to give a report on the success of these introductions.

SEED FARMS

The seed farms, which are all financed by Local Native Councils, now play a very important part in agricultural development in the native reserves. Their main function is the bulking of improved seed for issue and the demonstration of better farming practice. Ranges of plots have been laid out on a number of the farms, to facilitate the carrying out of local investigational work. The numbers and acreages in 1938 were as under:—

Province				Number of Farms	Total Acreage	Acreage under Cultivation
Nyanza	..	..	..	4	718	361
Coast	..	..	..	3	360	294
Central	..	..	..	12	406	302
TOTAL ..				19	1,484	657

In the Central Province each farm is being run as a mixed farming unit, and fields are being fenced in for a rotational grass ley. These demonstrations are having their effect and numerous natives are commencing to farm stock and crops together. Grass work is therefore becoming of great importance.

Apart from the seed farms there are a number of small plots throughout the reserves, mostly of a temporary nature, which are maintained from departmental funds and which are used for various lines of investigation as required.

It is probable that a seed farm will be established in the Taveta district next year.

SEED AND TREE ISSUES

	Nyanza Province	Central Province	Coast Province
FROM LOCAL NATIVE COUNCIL SEED FARMS	<i>Bags of 200 lb.</i>	<i>Bags of 200 lb.</i>	<i>Bags of 200 lb.</i>
Maize	177	1,040	49
Sorghum	54	9	123
Millet, Eleusine	83	—	—
Millet, Other	—	205	8
Rice	102	—	*91
Wheat	—	21	—
Potatoes	—	440	—
Beans	2	—	—
Beans, Rose Coco	—	158	—
Beans, Canadian Wonder	—	30	—
Beans, Boston	—	222	—
Beans, Tepary	—	—	7
Peas	—	31	—
Peas, Victoria	15	—	—
Peas, Pigeon	$\frac{1}{4}$	—	10
Groundnuts	44	—	—
Grain	—	13	—
Cowpeas, New Era	—	—	17
Mango Seed	1	—	—
Wattle Seed	37	45	—
Avocado Seed	4	—	—
Fruit Trees, Miscellaneous	5,743	21,155	—
Orange Seedlings	—	300	—
Rough Lemon Seedlings	—	50	—
Avocado Seedlings	—	203	—
Coffee Seedlings	—	3,629	—
Forest Timber Trees	1,030,819	45,185	—
Coco-nuts	—	—	500
Vegetable Seed (packets)	4,256	—	—
Cassava Cuttings	Small quantities	55 tons	—
Napier Grass Cuttings	†	160 tons	—
Tobacco Seed	—	—	2 lb.
FROM AGRICULTURAL DEPARTMENT FUNDS	<i>Bags of 200 lb.</i>	<i>Bags of 200 lb.</i>	<i>Bags of 200 lb.</i>
Maize	2	13	—
Sorghum	7	Samples	—
Millet, Eleusine	5	—	—
Wheat	—	—	—
Rice	—	—	*9
Potatoes	—	110	—
Groundnuts	31	—	—
Grain	—	Samples	—
Avocado Pear Seed	2 $\frac{1}{2}$	—	—
Mango Seed	6	—	—
	<i>Number</i>	<i>Number</i>	<i>Number</i>
Orange Seedlings	—	93	—
Avocado Seed	—	700	—
Avocado Seedlings	—	104	—
Fruit Trees, Miscellaneous	—	192	—
	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>
Coffee Seed	—	15	—
Pineapple Seed	—	10	—

Bags of 150 lb. †Issues taken from specifications.

AGRICULTURAL EDUCATION OF AFRICANS

As explained in the 1937 Annual Report, the agricultural education which is carried out or supervised by this Department is divided into (a) training of Africans to become better farmers and instructors in this Department; (b) supervision of agricultural education at elementary schools in the native reserves; (c) instruction of pupil labourers on seed farms.

All these three services were continued in 1938 in the three main provinces, and in Elegyo and Suk. Every endeavour was made to help with the agricultural work at such schools as exist. To these may be added, to make the picture complete, the agricultural education of the multitude in the fields and markets.

*Nyanza Province**Training*

It was again impossible to recruit apprentices who had passed the Primary School Examination. Twenty with as high a standard of education as possible below that were taken on at the beginning of the year at Bukura and the three years' course was continued. The curriculum has been modified to suit and attract post-primary boys. The waste occasioned by apprentices going to Bukura for what general school education they can get, with no intention of taking seriously to farming, will be removed when the desired higher standard of education of recruits is achieved.

A tribal analysis of all apprentices in training at Bukura in 1938 is given below:—

Tribe	Left December 1938	Leaving December 1939	Leaving December 1940	Total at beginning of year
N. Kavirondo (Bantu)	6	6	7	19
C. Kavirondo ..	3	2	2	7
S. Kavirondo ..	2	2	2	6
N. Kavirondo (Luo) ..	..	..	1	1
C. Kavirondo	2	4	4	10
S. Kavirondo	2	3	2	7
Nandi	1	..	..	1
Lumbwa	..	1	..	1
Elgeyo	..	1	1	2
Kaptama (N. Kavi- rondo)	..	1	..	1
<i>Total</i> ..	16	20	19	55

By having four complete smallholdings within the Bukura farm it has become possible to give apprentices a very useful knowledge of the value of stock in agriculture. Apprentices spend a proportion of their time running the holdings. In addition, each has a 1/20th acre plot in which to practice the art of growing crops. These plots have been cropped twice a year without a break since 1928, and the land is now in much better heart, than it was in 1928. Second and third year apprentices are regularly seconded to do extension work in the neighbouring reserve, thereby gaining experience in the field. Agricultural record books are now in use at all sector schools and definite progress is being made in the agricultural instruction given at these schools.

Pupil labourers are given instruction at all the seed farms, aimed at fitting them to become better farmers.

Refresher courses in agriculture for instructors and teachers are held every year.

Central Province

The training of instructors in this Province is done at the Scott Agricultural Laboratories. There were 58 apprentices in residence in 1938, 21 having entered at the beginning of the year. These were drawn from the following districts in the numbers shown:—

Meru	2	Kitui	1	Machakos	9
Embu	10	Kiambu	7	Teita	2
Nyeri	21	Fort Hall	6		

Three of the recruits were discharged as being unsuitable and 24 apprentices left the school at the end of the year on the completion of their course. Of these, nine have become agricultural instructors, two are agricultural teachers at missions, and one is employed as a coffee recorder.

The only amendment to the curriculum was the introduction of twenty minutes' physical drill each morning. Special attention was paid to instruction in soil conservation. Apprentices in their final year each spent three separate weeks on the smallholding, working under the supervision of the apprentice in charge. From the smallholding two heifers and a bull calf were supplied to the Senior Agricultural Officer, Central Province, for distribution in the Province.

The District Education Boards of the South Nyeri, Embu, Fort Hall, and Kiambu districts employed agricultural instructors, who worked under the supervision of the

agricultural officer or the assistant agricultural officer in charge of the district. These instructors help in the lay-out and operation of school gardens and give agricultural lectures at schools. The employment of instructors by District Education Boards is at present confined to this Province.

Refresher courses in agriculture for teachers are held every year.

Coast Province

In 1938, 29 apprentices were in training at Kibarani, of whom five completed their three-year course. The standard of education of recruits is increasing annually, but is not yet high everywhere.

Much closer relations now exist with missions over educational problems in this Province, and the results of this co-operation are apparent. An approved rotation was adopted in school gardens and seed of new crop varieties was issued. Schools were visited frequently by officers, and lectures and advice were given.

Four Church Missionary Society teachers took an agricultural course at Kibarani in 1938, and agreement was reached with mission authorities for the extension of this scheme in a modified form in future years.

The co-operation of missions in all Provinces is acknowledged with thanks.

PASTURE IMPROVEMENT

The value of good pasture is now beginning to be appreciated by native cultivators in most parts of the three agricultural Provinces. The need for good grassland, both to facilitate good farming practice and to prevent soil erosion, is mentioned elsewhere. Here it may be pointed out that the present need is for palatable, drought-resistant types of grasses suited to the varying local conditions which occur. In the Nyanza Province, trials of various grasses are being conducted on the smallholdings at Bukura (North Kavirondo). The best drought-resister so far in use in that Province is *Brachiaria brizantha*, which is most satisfactory in mixture with other grasses. Rhodes grass and *Paspalum dilatatum* have also been found to be satisfactory, but are not in general use yet. The most common useful grass in the 4,000 ft. to 5,000 ft. belt is *Paspalum scrobiculatum*. Kikuyu grass is a natural regenerator in the higher, well-watered areas.

Vegetation Surveys

A vegetation survey was made of the Machakos Yatta Plain by the Agricultural Officer in charge of Pasture Research in connexion with the application of a scheme of extensive control of grazing under native conditions. This scheme was started as an experiment at the beginning of the year in a 300-square-mile area of the Machakos Yatta Plateau. Effective control of stock movement, and consequent vegetation improvement, appears to have resulted, but trouble was experienced with water supplies in the northern part of the area.

Cattle Fodder Arboreta

An arboretum is established at Machakos. A site was prepared late in 1938 for an arboretum near Narok. Arrangements were made for the planting of suitable species for trial. Special species were under trial in the Kamasia Reserve, of which *Caesalpinia spinosa*, *Sterculia diversifolia*, *Ceratonia siliqua*, *Tetragonia arbuscula*, nettle elm and saltbush were satisfactory. *C. siliqua* was slow. Certain species have also been issued to District Commissioners up and down the country.

The following note on the trees at Machakos is of interest:—

Brachychiton rupestre.—9 survive out of 20 planted. Growth now 3 to 6 feet high; healthy.

Euc. microtheca.—19 survive out of 20. Growth 6 to 15 feet high. Some plants have got well ahead of others. There appears to be a slight variation in the foliage of individual trees.

Brachychiton populneus.—14 survive out of 20. Very dense, shady foliage. Variation in the leaf blade; some have three divisions and other trees five divisions.

Phytolacca dioica.—14 survive out of 20. Growth 6 to 15 feet high. Very heavy leaf fall in the dry weather; young shoots now bursting (*N.B.*—Before the rain has come); healthy.

Disperma trachyphyllum.—This is not a tree, but a whippy shrub. It is a most prolific self-seeder, and has completely covered the ground in its block with a very strong growth. Seems inclined to some leaf fall during the dry weather.

Celtis sinensis.—15 survive out of 15. All healthy except one plant. Average growth 10 feet. Good leafage during the dry weather, but has rather a whippy, peach-like growth.

Acacia spirocarpa.—There are apparently two *Acacia* species in this plot. There can be no report until identification has been made.

Prosopis juliflora.—Very poor, stunted growth. Five out of 20 survive. The survivors appear healthy.

Eucalyptus albens.—14 survive out of 20. Growth average 10 feet. Healthy progress.

Casuarina stricta.—Practically a complete failure. Out of a planting of 20, only two good trees have survived.

The Australian salt bush and the spineless cactus are both making good growth.

INVESTIGATIONAL WORK

Nyanza Province

Soil Fertility Experiments

The results of the long-term soil fertility experiment at Bukura, described in last year's Annual Report, will become available in 1941.

The interplanting experiment at Kakamega, consisting of a comparison of methodical (in rows) mixed planting and random (broadcast) mixed planting, together with a test of the effect of a Napier grass ley, started in 1935, was continued. A mixed stand of eleusine millet and sorghum in the long rains of 1938 was the seventh consecutive crop to be taken off the land. Up to then, two-thirds of the land under this experiment had been cropped and one-third had been under Napier grass. In the short rains, 1938, the cropped two-thirds were put under Napier grass also, and the other third (one acre), having been under Napier grass for four years, was prepared for cropping in the 1939 long rains. So far there has been no significant difference in yield resulting from random and methodical mixed planting at the same seed rates. The effect of the Napier grass ley will become apparent in 1939.

Trials of various species of green manure and cover crops are made annually. *Crotalaria incana* is still considered to be the best for altitudes between 5,000 and 6,000 feet, with heavy rainfall, in this Province.

Grass Trials

Rhodes Grass.—Fields seeded directly at Bukura failed to germinate satisfactorily. Sowings made in seed-beds at Bukura and Kakamega were successful, and seedlings were transplanted to the field and grew very well.

Paspalum dilatatum.—Direct sowing in the field failed. Consequently, fields were planted with seedlings at Kakamega, Bukura, Maseno and Kibos. This grass has withstood drought well and is forming a very close growth of good feeding value. It has developed much more slowly than Rhodes grass.

Napier Grass.—The Uganda strain was compared with the local strain at Bukura. The Uganda strain is shorter and forms a finer type of growth, which might be more suitable for the rejuvenation of land, but which would be unlikely to replace the local strain for cattle-feeding purposes.

Cover Cropping and Control of Couch Grass.—At Bukura, in the 1938 short rains, observation strips, each 100 yards by 32 feet in measurement, were planted with various cover or smother crops in order to gain information on the possibility of controlling couch in this way. The crops used were:—

Pigeon pea	...	...	...	4 ft. x 4 ft.
Pigeon pea		...	...	3 ft. x 3 ft.
Pigeon pea	...	...	...	3 ft. x 2 ft.
<i>Helianthus</i> sp.	...	...	...	4 ft. x 4 ft.
Black Mauritius beans		...	...	3 ft. x 6 in.
Rye				
Oats				

Maize is grown in one of the strips. The pigeon-pea strips will be allowed to form a weed undergrowth. Already couch has come into the rye and oats strips, but the *Helianthus* sp. has made a complete cover under the shade of which nothing is likely to grow.

Sweet Potatoes

Six varieties were obtained from Amani in 1937 and were multiplied at Maseno. In the 1938 long rains a yield trial was planted with the once-grown material. Progressive harvests were made between 130 and 180 days from planting. The varieties Russian Leaf, Linslade Leaf and Yellow Jersey Leaf were the best yielders and the most palatable. These three varieties are now being multiplied for issue.

Cassava

Thirty-five local and imported strains are under observation at Maseno for mosaic resistance, yield and palatability.

Cotton

Eighteen trial plots, representing all cotton-growing conditions in the Province, were kept in use in 1938.

The following matters were under investigation at these plots, the number in the right-hand column being the number of plots at which the particular type of trial was conducted in 1938:—

(a) Time of sowing	...	...	...	...	10
(b) Spacing	...	...	...	...	7
(c) Varieties	...	...	...	...	4
(d) Interplanting with catch crops	...	...	...	...	4
(e) Growing in raised beds versus flat land	...	...	...	...	2
(f) Mulching for moisture conservation	...	...	...	...	3

Tobacco

Boron deficiency in North Kavirondo tobacco soils was under investigation at Bukura. Borax at the rate of 10 lb. per acre was applied to the soil in which tobacco seedlings were growing in order to find out if there was any indication that a boron deficiency was related to the incidence of "rosette" disease of tobacco. Results so far indicate the possibility of there being a correlation, the application of borax effecting a very slight, but non-significant, reduction in the incidence of the disease. The investigation is to be continued.

An experiment to determine optimum interplant spacing and the optimum number of leaves which should be retained per plant for smoking leaf production had to be abandoned owing to a very severe infestation of eelworm. Arising out of this abortive experiment, it is worth noting that the crop on rich soil was not completely ruined by the eelworm.

Rice

In 1938 the annual rice variety trials in North Kavirondo were destroyed by hail. Only enough seed for re-sowing was harvested.

The variety trials at Saka escaped destruction. The yields and order of merit of the varieties in this trial are tabulated below:—

VARIETY	Yield per Acre	Order of Merit
Bungala	18.9	7
Lady Wright	17.5	9
Cross-bred		
Halkadui	19.3	6
Mumias	21.9	5
Peshawri	18.6	8
Faya	28.7	2
Sena	24.0	4
Colora II	14.2	10
Maji Maji	27.7	3
Ambarikoro	33.6	1

It was found that the stocks of Ambarikore and Faya in this Province are the same. This type will in future be known as Faya, which is a well known name in East African markets. It is a heavy yielder, and is highly palatable.

Groundnuts.

As the result of experiments in a number of consecutive seasons, it has been proved that, in the groundnut-growing districts of this Province, the best yields are invariably obtained from early sowings. The 1938 time of sowing experiments supported this conclusion.

Eleusine millet.

A variety trial comprising five local white varieties, five local red varieties and Bukura (red) was grown at Kisii. The variety Bukura matured a full month before any of the local varieties, but it gave a lighter yield than any of these. Further selections were made of this variety for earliness and for resistance to blast.

Treatment of Grain with Wood Ashes.

200 lb. of Kano sorghum grain mixed with wood ashes was stored for twelve months. At the end of that period there was no sign of grain weevil attack. Untreated seed stored for the same period had been attacked.

Central Province

This Province has no real experiment station. Investigational work has therefore to be done on the seed farms and at separate plots.

Cereals.

In a trial at Embu to test the effect on maize of mulching, the mean yield of three plots was 880 lb. per acre for mulched maize and 330 lb. per acre for unmulched maize.

At Kitui, maize, sorghum and awned bulrush millet were under trial to discover which gave the best yield of grain under local conditions. The results were: —

Bonganhilo Sorghum	..	..	1,720 lb. per acre
Katengu Sorghum	..	..	1,240 " "
Muratha Maize	..	..	1,360 " "
Awed Bulrush Millet	..	..	1,000 " "

Excluding Bonganhilo, which is not popular in Kitui, there is little to choose between maize and the other sorghums.

A randomized block manurial experiment on beans, using 2, 4 and 6 tons of farmyard manure per acre, gave no significant results. The residual effect on maize is now being tested.

Soya Beans.

Fourteen non-shattering varieties of Soya bean are under trial at Nyeri. The first growing season was very dry and only sufficient seed for resowing was harvested.

Boston Beans.

Yield trials showed that Boston beans do well in the low, dry areas of this Province.

Potatoes.

Four varieties introduced from the United Kingdom, with a view to discovering a better variety for the potato-growing areas of this Province, were grown in a yield trial with Kerr's Pink, the variety at present mostly grown. The yields obtained were as follows:—

Sutton's Ben Lomond	..	..	7,832 lb.	per acre
Duke of Kent	..	..	7,691	" "
Kerr's Pink	..	..	5,819	" "
Glen Cova	..	..	5,567	" "
Commander	..	..	5,535	" "

(Note.—Only 12.97 inches of rain fell in the growing season.)

Arabica Coffee.

The effect of mulching on the bearing of a number of types is being tested at Meru.

Some old trees at Meru, stumped early in 1936, were pruned on the single stem principle, while others were pruned on the multiple stem principle, for comparison. These commenced bearing in July, 1937. Yields from four alternate rows of 12 trees each are given below:—

1937 : Single Stem	..	..	98 lb.	dried cherry
Multiple Stem	..	..	140	" "
1938 : Single Stem	..	..	137	" "
Multiple Stem	..	..	166	" "

Cotton.

Cotton production in the Central Province is fraught with difficulties and investigation is required to discover the cause of boll shedding, so prevalent in all areas between July

and October. Four cotton experimental plots have been opened, two in the Embu District, one at Kitui and one at Machakos. Second order meteorological stations were opened at the two Embu plots, instructors having been trained in the recording of meteorological data. The work described below has as its object the discovery of types suited to Central Province conditions and the discovery of the optimum method of culture.

Variety of Spacing Trials.—Varieties under trial were U4, N17, B998, B052. Spacings tested were 3 ft. x 1 ft., 3 ft. x 1½ ft. and 3 ft. x 2 ft. Trials were at Kitui and Machakos. 1938 was the third year of these trials. Each year U4, the variety at present grown in Machakos and Kitui, and 3 ft. x 1 ft. and 3 ft. x 1½ ft. spacings, have proved to be best.

Variety Trials.—Eighteen varieties were imported from Uganda, Southern Rhodesia, and Nyasaland in 1937 for trial at Machakos, Kitui and Embu. The varieties from Uganda and Southern Rhodesia were the most promising after two seasons of trial, particularly the Uganda variety B.P.52, which is a clean, heavy yielder, with an early, concentrated crop. The growing period is five months. The order of merit is given under:—

Yield	Lint Quality	Earliness
B.P. 52 (U)	G.5.30 (S.R.)	B.P. 52 (U)
B.P. 104 (U)	U.4.N.10 (N)	G.5.79 (S.R.)
U.4.N.10 (N)	B.P. 52 (U)	G.5.30 (S.R.)
G.5.79 (S.R.)	H.L. (N)	G.5.123 (S.R.)

NOTE : U—Uganda. N—Nyasaland. S.R.—Southern Rhodesia.

Time of Sowing Trials.—At Embu a trial was laid down to compare long and short rains sowings, at different spacings, of cotton alone, cotton interplanted with other crops, and cotton alone but mulched. Yields, the indicator in this trial, were very poor owing to adverse climatic conditions; the short rains cotton almost completely failed. The incidence of stainers was very high because of the presence of indigenous malvaceous plants which this year set hardly any fruit. The results of this trial were therefore inconclusive.

Mulching.—Mulching of cotton in the drier areas of Central Province has, in three successive seasons, proved to be detrimental to the yield of cotton.

Rattooning.—Numerous trials carried out in three successive seasons have indicated that ratooned cotton in the second year will not produce as good a crop as cotton in its first year of growth.

Interplanting Trials.—A test of interplanting with green gram and with Boston beans between rows of cotton spaced at 3 ft. x 1 ft., at Embu, showed that green gram was not detrimental to the cotton crop, but that Boston beans caused a reduction in cotton yield.

Cotton at 3 ft. x 1 ft., 3 ft. x $1\frac{1}{2}$ ft., 4 ft. x 1 ft. and 5 ft. x 1 ft. spacings was interplanted with beans, and cotton was sown pure at 2 ft. x 1 ft. in a cash return investigation at Fort Hall. Cotton sown at 3 ft. 1 ft. spacing interplanted with beans gave the highest cash return, viz. Sh. 55/49 per acre (including proceeds of sale of beans).

Stainers.—The first generation of the stainer *Dysdercus fasciatus* was noted in cotton in March, and of *Dysdercus cardinalis* on 15th June. In July *Thespesia* fruits began to ripen and *D. fasciatus* were on them in large numbers, leaving very few in the cotton. With the advent of rain in October the first major generation of *D. cardinalis* instars was apparent in Mbera and in November *D. fasciatus* left the *Thespesia* trees for cotton. In December, *D. nigrofasciatus* began to appear in cotton in Mbera in considerable numbers. In August *Dysdercus superstitionus* was found on *Hibiscus gossypinus* in Gathara's location. This is believed to be the first time that this species has been recorded in the Central Province.

Coast Province

The investigational centre for this Province is the experiment station at Kibarani, the development of which proceeded on the lines outlined in last year's report. Trials are conducted in outside plots also, as required. Excessive rain caused crops to yield poorly.

Soil Fertility Experiments.

Soil Renovation Experiment.—After one year under the resting crop, last year's results showed that pigeon pea was relatively of greater value than grass fallow, Napier grass and Mauritius beans, and that the two last-named were better than grass fallow in restoring fertility to worn-out land. The 1937 short rains indicator crop maize failed, but maize was again used in the 1938 long rains to test residual effect. Yields of maize on all the four treatment plots were low and it is concluded that one year under any of these resting crops will only

give a satisfactory increase in yield in the first season after they are turned in and that it is consequently desirable to lengthen the period under a resting crop. The effect of putting land under resting crops for one, two or three years, is now being tested.

Fertility of Coco-nut Land.—So far, no differential effect in yield of coco-nuts has appeared as a result of the various soil treatments. The treatments are : seaweed dressing; artificial fertilizers; green manure; fallow.

Crop Trials.

Cotton.—Cotton suffered from unfavourable weather conditions, jassid, with consequent boll shedding, and to a less extent from boll worm. In October and November jassid disappeared, resulting in an apparent temporary recovery of the plants. Nevertheless, boll shedding continued to be severe and the majority of unopened bolls were diseased. Consequently, all investigations were adversely affected. An investigation into the cause of this condition is being made by the Senior Plant Breeder.

The selection for improved types was continued. It is disappointing that all selections, even those which showed promise in 1937, were severely affected by jassid and boll-shedding. The Barberton and Southern Rhodesian varieties, introduced in 1937, were also disappointing in this respect. Harland's Cambodia crosses from Southern Rhodesia showed the best resistance to jassid in 1938, A.F.C.15 being outstanding. Further comment will be possible when these varieties and crosses have become acclimatized.

Barberton varieties 998 and 9243 were in the multiplication stage in 1938, because of the resistant qualities they had previously shown. Even they were disappointing, but will be issued in 1939 in small areas, as they yield better and have a better ginning percentage than the local N.17.

Mean results of type trials were as under:—

		Yield per Acre	Ginning Percentage	Weight of 100 Seeds
		<i>Lb.</i>	<i>Per cent</i>	
1936 Kibarani Selections	..	377	35.60	7.77
Barberton Varieties		458	36.43	6.82
S. Rhodesian Varieties		518	34.78	6.56
Cambodia Crosses		554	37.92	7.26

Variety trials of 998, 9243, 955 and the local N.17 were carried out at Kibarani and at four outside plots at various places in the cotton-growing areas of the Province. The only significant yield differences were at Kibarani, where 998 and 9243 yielded better than N.17. Average ginning percentages were:—

998	...	37.8
9243	...	36.6
955	...	38.0
N.17	...	3.27

Although there are many wild stainer hosts in the area, a wild type of cotton, referred to in last year's report, which grows on the northern mainland of Lamu, becomes stained to a surprisingly small extent. A plot of this cotton was grown at Kibarani in 1938, but no useful observations on its behaviour to stainers are yet possible.

A further study was made of the effect of interplanting maize with cotton and sorghum was included in the investigation. Adverse conditions spoilt the yield of the cereals. For this reason the results so far obtained can only be regarded as indicating that it is probable that a suitable interplanting method for coast conditions will be found after further investigation.

Interplanting one row of groundnuts between cotton rows spaced at $3' \times 1\frac{1}{2}'$ resulted in the groundnuts having a depressing effect on cotton yield.

The effect of mulching cotton with Napier grass was tested in a randomized block experiment. The mulch was put in early in July, before dry conditions set in. Mulch helped early vegetative growth, but did not affect the incidence of jassid or boll-worm. Quite unexpectedly, the unmulched cotton ripened the earlier, but the mulched plots gave a slightly heavier yield.

An investigation into the cause of boll-shedding was begun. Shed bolls were collected from 360 individual plants, half of which had been severely attacked by jassid, the other half being comparatively free. (It was impossible to find completely healthy plants for comparison.) It was found that boll-worm accounted for 32.3 per cent of the shedding. No significant difference was found between the number of bolls shed by the heavily and by the lightly jassid-infected plants.

The problem was next approached by a study of the plants themselves, of the healthy bolls and buds they were bearing, and of the diseased boll scars of shed bolls. The following results were obtained:—

- (1) The total number of flowers produced by both heavily and lightly attacked plants was the same, on the average.
- (2) The number of diseased and fallen bolls was significantly greater on the heavily attacked plants.
- (3) The number of healthy bolls and buds was significantly greater on the lightly attacked plants.

The apparent discrepancy between the results of these two methods of investigation is probably due to the fact that the shed bolls which were collected represented only the latest falls, the previously shed bolls having rotted away.

The percentage of shedding on the lightly attacked plants was 53 and on the heavily attacked plants it was 78. It was finally concluded that some cause of shedding other than bollworm and jassid was present. The nature of this unknown factor is being studied.

Cassava.—The observational variety trial of Malindi seedlings and of varieties from Amani was continued with additions. Those that came through the previous year without signs of mosaic were multiplied on a small scale. With two exceptions, all developed mosaic and were discarded. The exceptions were M2 (one plant showing mosaic) and M5 (slight mosaic). It is doubtful if these will rival the parent Malindi. The newer seedlings will be again under observation in 1939.

The possibility of obtaining resistance to brown streak disease as well as to mosaic was considered after discussions with Dr. Storey of Amani. Some of the newer Malindi seedlings appear to possess some measure of resistance to brown streak. Observations on susceptibility to this disease will be continued in 1939.

Malindi itself continued free from mosaic in most of the multiplication plots. A few plants in one plot showed mosaic. The behaviour of infected cuttings from these plants was studied. Of 27 cuttings, planted in August, three were free from mosaic at the end of the year, thirteen were badly diseased, and eleven were slightly diseased.

Maize.—New seed of Durum, imported at the end of 1937, was found to be very variable in character, both dent and flint types being present. Selection and inbreeding will be necessary to fix the most desirable type. This will be started in 1939.

Sorghum.—Selection for yield without loss of earliness, foreshadowed in last year's report, was begun. Statistical examination showed that size of head and weight of grain are complementary factors affecting yield of head. Neither taken alone gave a significant correlation with yield, but a high positive correlation was obtained by considering them both together. Selection is being carried out on the lines indicated by this study.

Foxtail Millet.—The wet season was unfavourable for this crop. 1937 selections were grown and more mass selections were made in each plot.

Rice.—Variety trials were continued at Kau. The medium early variety Sindano did well, but it will probably only be of value in the irrigated area. In the short season varieties, the introduction of Peshawari has been hitherto outstanding; but recent milling reports of it are rather disappointing. Of the new varieties under trial, Basmati is outstanding, maturing in 137 days, yielding well and giving no trouble in hulling. In a later trial it matured in 105 days, and yielded 2,100 lb. per acre. This rice commands a high price.

All the maritime districts grow rice in rain-filled swamps, for which short season varieties are essential. With good short season varieties becoming available as the result of this Department's work, cultivation in these districts, as distinct from the irrigation growing areas, which do not depend on short season varieties, will increase.

Pulses.—The selection of New Era Cow pea for earliness and high yield crop was started in 1938. The selection of New Era pigeon pea for yield progressed. Selection of tepary beans for creeping habit was continued.

Sesame.—Attacked by aphids, a mosaic-like leaf infection and lateness in maturing, were observed in Lindi sesame in a trial plot in the 1937 short rains. These conditions were again observed in 1938, but Kitui sesame was considerably better, under trial conditions. This matter is to be studied further with a view to introducing a variety which is better than the Lindi sesame.

Miscellaneous.

As bananas are being grown to an increasing extent in this Province, it was decided to establish a plantation of different types. Twenty-two different types, from the Kavirondo districts of Nyanza Province and from Uganda, were planted in 1938.

Cluster bean has done well for two years and has now been sent to seed farms for bulking for issue.

Wilt Disease of Groundnuts.

In the present season ninety-three plant-to-row selections were sown, as well as a number of small bulks of the best strains in 1937. Stands were seriously affected by the adverse conditions at planting time. Nevertheless, from the point of view of resistance to wilt, the season was encouraging. Whilst certain strains had no wilted plants, a more satisfactory method of considering wilt resistance is to take the progeny rows as a whole. This gives an average percentage of wilted plants in these re-selections of 9.5 against the previous year's average of 25.5. From observations made, it appears probable that this improvement has been due more to the elimination of poorer strains than to an actual increase in resistance in the better strains. Nevertheless, if this degree of resistance is maintained, even if not improved, in 1939, the growing of groundnuts at the coast will become a practical proposition.

Yields were affected by poor germination, but were definitely encouraging. All plants bearing less than 30 nuts were rejected and yields were only taken on the remainder. Unfortunately, owing to difficulties at planting time it had not been possible to plant all progeny rows the same day, and the second planting suffered heavier losses at that time. Accordingly, yields are best shown as in the following table:—

YIELDS OF PROGENY ROWS—1939

	Percentage Stand	Yield per Acre*
First Planting	70	1,341 lb.
Second Planting	49	733 lb.
Average of all Rows	59	1,025 lb.

*Yield after discarding all plants with less than 30 nuts.

The behaviour of strains, which descended from an original selection No. 28, was commented on last year. These derived from two plants, 28/C/1 and 28/C/2, which were caged in 1935 to ensure self-fertilization. Re-selections in these strains now form the bulk of the present progeny rows and their consistently good behaviour is a satisfactory feature.

In the bulks derived from selections made in 1935 and 1936, the average percentage of wilted plants was 21 for the 1935 and 8.1 for the 1936 selections. Yields were affected by poor germination, but were not satisfactory.

NATIVE PRODUCE

Inspection and Marketing Services

The Marketing Officer, Mr. C. O. Oates, who has prepared this section of the report, was on overseas leave from the 2nd April to the 22nd November, and during his absence the staffing of the Department did not permit of a relief. In spite of the absence of the Marketing Officer, however, considerable progress was made with the marketing and inspection services during the year.

Whilst on leave, Mr. Oates conducted investigations into markets in Great Britain for Kenya products and was able to obtain a considerable amount of information.

Inspection Services

Native inspectors have now had three or four years' experience, with a consequent increase of efficiency. Considering the fact that, apart from help given by the Marketing Officer, these services are but a small part of the duties of the field staff, the standard of efficiency now obtained is very gratifying. During the year under review no fewer than 1,344,726 bags of produce weighing 200 lb. were inspected at the Native Produce Inspection Centres. In most cases these services are self-supporting, and thus the great improvement which has occurred in the native crop produce of Kenya has been brought about at no cost to Government other than that of the agricultural officers concerned, who make it a part of their large range of duties.

As funds have become available throughout Central and Nyanza Provinces, the inspection centres have been improved and, though there is still room for improvement, the general standard of the inspection centres and their equipment has shown a great advance during the last two years.

The experience obtained in the working of the inspection centres has now resulted in very little produce leaving the native areas concerned without inspection. The provision of a native inspector in Nairobi has acted as a deterrent to night transport of produce by motor lorries in the Central Province, whilst check inspections at Kisumu have had the same effect. Complaints of inefficient inspection by merchants, though few in number, have covered a wide area, thus showing that merchants appreciate the need of efficiency in the service. This is a change from the early days of native produce inspection, when most merchants pretended to take no notice of it, and looked upon it as a nuisance.

Another gratifying feature as regards these services is that, during the last three years throughout the whole of Kenya, there have been fewer than fifty prosecutions for attempted evasion, thus showing that the services are now taken as a matter of course.

The systems of inspection in vogue in the Nyanza and Central Provinces differ from each other. In Nyanza inspection is carried out at all the small markets throughout the district, and consists of examining the small baskets of produce brought in. Further inspection takes place on the perimeter of the districts, and it is hoped in time to do away with inspection at small markets when the cultivators have been educated up to a standard that will result in their bringing good produce to these markets.

In the Central Province inspection is confined to the outlets from the districts, and is really the inspection of produce brought in by the native traders who, in order to obviate the necessity of sorting the produce themselves, make the producers do so before they purchase it at the small markets in the district.

Central Province.

The quantities of produce presented for inspection were in every way a record, something like 650,000 bags of 200 lb. being passed by the inspectors. In addition, 14,000 tons of wattle bark were also inspected. The big increase in crop produce was accounted for by maize (over 400,000 bags) and potatoes (120,000 bags), and during the latter months of the year the inspection centres were placed under a great strain by the amount of produce presented for inspection. The fact that the services operated smoothly in all districts reflects great credit on the agricultural officers and native staff.

The new system of wattle inspection, described in the 1937 annual report, has also worked well. This system has an advantage which was not at first realized, in that the native wattle inspectors operating in the reserve are now able to inform officers in charge of the district when good bark is getting scarce in any particular area. In the Kiambu District the inspectors had great difficulty in finding good trees to cut in the second 1938 season, and after some immature bark had found its way to the inspection centre at Ruiru they were able to inform the Assistant Agricultural Officer, Kiambu, of their difficulties. As a result Kiambu District has been closed to wattle bark sales during 1939.

The following schedules show the quantities of produce which have passed through the various centres during 1938 :—

DISTRICT	Wattle		Maize and Maize Meal	Legumes	Potatoes
	Dry	Green			
	<i>Tons</i>	<i>Tons</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>
South Nyeri..	1,325	—	65,597	8,756	50,141
Fort Hall ..	5,620	1,944	188,009	22,323	—
Embu ..	252	—	86,007	28,232	1,099
Kiambu ..	3,498	556	15,576	3,829	69,773
Meru ..	—	—	27,160	15,159	—
Machakos ..	954	—	41,158	7,305	—
Kitui ..	—	—	—	—	—
TOTAL ..	11,649	2,500	424,407	82,604	121,013

Nyanza Province.

In this Province the inspection system continued to rest on the individual load examination of produce at markets with the object of educating the individual producer. This system has many advantages, but also has the disadvantage that produce may be mixed after inspection at the small markets. This, however, is checked by a further inspection on the perimeter of the districts.

In North Kavirondo the agricultural officer had a somewhat difficult year in dealing with merchants who endeavoured during rush periods for export to evade inspection, loading inferior maize, and it was necessary for him to prosecute several of them.

The maize from the Broderick Falls area is the best native maize in Kenya; in fact, the Chief Grader and Inspector at Mombasa has reported it to be one of the few areas free from the yellow taint which is causing anxiety to maize growers in other areas.

Whilst in England, the Marketing Officer was able to discuss the question of Nyanza-grown groundnuts with the Imperial Institute, and inquiries are now being made in England as to the possibility of offering Nyanza nuts for the peanut confectionery and basket trade. This high standard has been obtained almost entirely by the efficiency of the inspection services.

Simsim continued to be of very high standard, but both this crop and the groundnut crop showed a big reduction in the amount presented for inspection during the year.

The inspection services introduced into the Kericho and Kisumu-Londiani districts in 1936 were consolidated, and their efficiency increased, with a resultant improvement in the maize being sold in the area. This improvement in quality has been reflected in a rise in the price ruling for Kericho maize.

The following quantities of produce were inspected during the year under review:—

PRODUCE	North Kavirondo	Central Kavirondo	South Kavirondo	Kericho and Kisumu-Londiani	Total
	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>
Maize ..	127,600	86,108	37,279	26,378	276,365
Groundnuts	—	1,298	16,192	—	17,490
Simsim ..	4,444	1,837	6,050	—	12,331
Beans ..	2,387	2,332	3,256	—	7,975
Choroko ..	2,200	2,112	253	—	4,654
TOTAL ..	—	—	—	—	318,815

Rift Valley Province (Nakuru District).

As has been stated in former years, inspection services in this area are far more difficult to work efficiently than in the native reserves. The fact that the Agricultural Officer, Njoro, has so many other duties and is Agricultural Officer for a very large European area, means that he cannot give such time to supervising the centres as can in any way be considered adequate. The complete absence of all native authority also makes work difficult for the native inspector.

Another difficulty has been that, if traders have wished to evade the Rules, it has been possible for them to do so by stating that any bad maize found on their premises is maize grown by Europeans and, although this is known not to be so, it is a most difficult fact to prove in a court of law. It can, however, be said that the inspection of maize grown by native labourers in the Rift Valley Province has resulted in such maize being greatly improved in quality, and this is freely admitted by even the critics of the scheme. During the next maize season (1939-40) it is probable that the scheme will be modified, and confined to the outlets of the district. It will still, however, be necessary to keep market centres open, and this will be dealt with under the Market Section of this report.

65,432 bags of maize were inspected.

Coast Province.

The work of improving the produce at the coast was continued and Section I of the Native Produce Improvement Inspection Rules was applied for this purpose. After consideration, it was agreed not to introduce further legislation for crop inspection, owing to the fact that seasons at the coast vary so greatly that the establishment of any successful service was considered to be problematical, owing to the possibility that there might not be any produce in any one year. It had been hoped to introduce the proper grading and inspection of copra, but the opposition to this measure by both producers and buyers, particularly those at Lamu, made it advisable to defer this measure.

Marketing Services

In the Central Province the marketing organization continued to work smoothly, and Nyanza Province was made a declared area under the Marketing of Native Produce Ordinance on the 29th July, 1938. In the Rift Valley Province the market centres proved most valuable.

The year under review showed a big drop in produce values, and in Nyanza Province a big drop in output. It can, however, be said that the marketing and organization was responsible, despite the drop in prices, for ensuring to the producer a better price for his crops than was the case a few years ago, when prices were higher, but the percentage taken by the middleman was very much greater.

One of the most interesting developments which has resulted from the organization of marketing of native produce has been the growth and spread of the native trading community. Before the service was undertaken, there was a fair number of native traders in the Kikuyu Highlands, traversing the reserves buying produce where they could, and at the lowest price at which they could obtain it, with faulty scales, bad stores, and with inadequate means of transport. The organization has corrected all these defects, and fair competition, with fair market value to the producer, and adequate local storage and transport, are now the rule. This has proved to be so satisfactory to the traders themselves that they are now to be found, not only throughout the Kikuyu Highlands where they were formerly, but in all other parts of the Central Province, throughout which marketing has been organized.

In addition, native traders are now to be found in other Provinces, wherever the marketing of the native produce has been organized; for example, in the Rift Valley at the local

market centres for purchase of native squatter maize, and in the Nyanza Province, where the Kavirondo and Luo tribes are following the example of the Kikuyus in taking up trading. Moreover, where this trading was confined formerly to the purchase and sale of native agriculture and produce, many traders are extending their enterprise to trading in ordinary merchandise.

Central Province.

During 1938 the value of the marketing organization of this Province was amply demonstrated, as the quantity of produce handled was fully 100 per cent greater than in any previous recorded year, and without organized marketing conditions would have become chaotic. Maize prices were maintained throughout the year, but potatoes showed a big drop towards the end of the year, the price for a time being as low as Sh. 1 per 200 lb.

The Kenya Farmers' Association (Co-operative), Ltd., continued to be the lessees of the Local Native Council godowns for buying native produce. Whilst they did not handle so much produce as had been hoped, they had a great effect in the stabilizing of maize prices.

The marketing organization in Nyeri and Fort Hall districts has been well-established for some time, and during 1938 Embu and Kiambu districts were brought to a standard of efficiency comparable with these districts. Meru District, by its position, and the rather more backward state of its inhabitants, is not yet up to this standard, but, due to a considerable amount of hard work put in by this Department and the Administration, with the assistance of an enterprising firm of Indian merchants, great progress can be reported during 1938. The Wakamba Districts of Machakos and Kitui are still much behind the old Kikuyu Province districts. In certain parts of Machakos however, natives are showing great interest in organized marketing, and native traders are actually taking to organizing bulk sales of their maize purchases. It is probable that in the near future a Local Native Council godown will be erected at Athi River Station. Meanwhile, the object of the agricultural officers is to keep these people on simple lines, and not to embark on any impracticable forms of co-operation.

Improvement in the buildings of the markets throughout the Central Province can be recorded. There is, however, much room for further improvement, and a drive will be made to this end. Whilst this is not really part of an agricultural officer's work, the officers of the Department have had so much to do

with the establishment of produce-buying markets in the native reserves that it is to them that the people look for stimulation in this direction.

In the report for 1937 a warning was sounded as to the increase in the number of native traders, and to their desire to undertake functions which brought them into uneconomic competition with buyers at the large trading centres, thereby increasing the number of middlemen in the districts far beyond requirements. During 1938 the endeavours to keep them in their proper places, that is, the native markets, have been successful, and, with the exception of native buyers of hides and skins, it can be said that native traders in the Central Province are performing their correct function, that is, buying produce in small quantities at markets in the reserves, bulking it, and transporting it to railhead or some large centre for sale. The only type of trader to whom this does not apply is the trader in hides and skins and there is still a great deal to be done in controlling these, as they journey round the country on bicycles, buying a few hides here and there at prices far below market value. It has not yet been practicable to bring hides and skins under the marketing legislation.

Nyanza Province.

As reported, the Marketing of Native Produce Ordinance was introduced into this Province during 1938, and 120 markets were gazetted under the Ordinance. The way had been well prepared for the introduction of the provisions of this Ordinance, and its introduction took place quite smoothly. In this Province there is a growing desire on the part of the natives to take a more active part in buying at the native produce markets which have been created. When the natives have taken plots at markets removed from the trading centres they have been a success, but when sites have been placed near the trading centres, where they have come into direct competition with the Indian traders, they have not been so successful. This is only to be expected, and is in fact to be hoped for, because, as has been stated in the section under the Central Province, invasion of the sphere of long-established middlemen at trading centres is undesirable.

In South Kavirondo the natives, until the year under review, had taken no part in trading. During 1938, however, a fair number started to operate as traders.

The Local Native Council godowns at Broderick Falls, Butere, Yala and Luanda, were again leased by the Kenya Farmers' Association (Co-operative), Ltd. This firm had also

offices, or stores, at Kisumu, Lela, Kisii and Kericho. By the introduction of this large concern, it has made the export of maize possible, thereby relieving congestion and preventing the former usual slumping of prices in the local market. During the year in Kericho District there was still a difficulty in entering the best local markets for the native-grown maize, and prices remained at approximately Sh. 4 per bag.

The bushel measure was introduced into Nyanza Province, but has not yet gained the popularity with the sellers which had been expected.

Rift Valley Province (Nakuru District).

The marketing system in this district, as has been stated in previous reports, is quite different from that obtaining in the native areas, and there will always be some controversy as to whether marketing services should be provided for crops grown by natives on European farms. Maize is the chief crop dealt with, and it can be said that, far from the amount grown by resident native labourers diminishing, it is on the increase, particularly since the introduction and success of the pyrethrum crop, which has increased greatly the amount of labour needed for certain farms. How long farmers will allow hundreds of acres of their land to be used for the production of native-grown crops is a matter for conjecture, but as long as such crops are produced in quantity it is the duty of Government to see that marketing facilities are provided; otherwise, conditions will become chaotic.

During the year the marketing scheme worked efficiently and it can be said that practically all the maize grown by squatters in the Nakuru District was sold at the market centres, and not, as formerly, on the roadside to drivers of lorries who transported it to Nakuru and other centres, often at night. Whatever may be the success or otherwise of the inspection services provided in the Nakuru District, there is no doubt that the market centres are performing a most useful service.

Native Council Marketing Services

The Kenya Farmers' Association (Co-operative), Ltd., leased the godowns from the Local Native Councils in both Nyanza and Central Provinces. As reported, this Association has had a great effect in stabilizing maize prices in both these areas. It is felt in some quarters that in the Central Province the time has come for the Local Native Councils to give up these godowns, and it might be as well to trace the history of this native authority enterprise.

Up to the year 1930 native trade in the Central Province was entirely in the hands of petty merchants who were in reality not produce merchants, but small shopkeepers. They had little or no experience of dealing in produce, and their handling of the crops purchased by them was both crude and wasteful. The Agricultural Department and the Administration had in the past made efforts to interest larger firms in the native produce trade. These efforts, however, had been unsuccessful, largely owing to the fact that the bigger firms had no bases on which to operate in the native areas, and consequently were at a disadvantage compared with the small traders, who had their stores in the trading centres. In 1931, as a result of encouragement received from the Agricultural Department, the Administration agreed to advise the Local Native Councils in Kiambu and Fort Hall to erect godowns at the railway stations, with the object of collecting native produce, and bulking for sale in quantity. Originally the intention was to use these godowns for group bulk sales of native produce, and a considerable amount of hard work was put in by the officers of the Administration and Agricultural Department in giving effect to this.

In two districts the Administration endeavoured to establish co-operative societies, but these failed. Group selling had a limited success, not in the sense that the collection and sale of produce failed, but because a small proportion only of the native produce was brought in.

At a later stage it was obvious that, for the native maize particularly, which comprised the predominant bulk of produce exported from the reserves concerned, it was necessary to have a purchaser in the area in possession of all the facilities for quick export, such as taking immediate advantage of overseas orders, making forward contracts, and shipping by charter; one who was, as well, in touch with all important overseas maize markets.

Negotiations were undertaken, through the Provincial Commissioners, for the leasing of the Local Native Council godowns to the Kenya Farmers' Association, and the Association began its operations on the 1st July, 1936. The result has been quite successful in raising the price of the native maize to parity with European maize, quality for quality, which normally is based on the export price, and substantial quantities of native maize have been exported, removing the farmer's annual glut, with its depressing effect on prices to

below export parity. Briefly, inspection ensured to the exporter sound maize suited to the oversea markets and the operations of the Association have ensured export parity prices to the producer.

The godowns have also served the wattle industry by making feasible the marketing on a basis of fair value of the many thousands of individual loads of bark that are brought in during the prescribed marketing season of the year. (Marketing is closed down during the two wet seasons of the year, because drying of the bark is most uncertain during these seasons.)

The increase in wattle bark production, as well as in the quantities of other produce coming into the large centres at which these godowns are established, led later to the firms purchasing the bark, erecting their own godowns, and for some time it has been the rule for all bark to be brought to these private godowns.

Native traders purchase the bulk of the bark, as of other produce, at the local market centres in the reserves, and it is a common sight to see many lorry loads of bark coming to the private godowns during the marketing season.

When the Local Native Councils first built these godowns there were no big firms operating in the native produce trade outside Nairobi. To-day, at places such as Karatina, apart from the Local Native Council godowns, there are stores belonging to three other big firms of produce merchants, and competition in all forms of produce is keen. The Local Native Council godowns have therefore achieved the object for which they were originally built, that is, for interesting big enterprises in the native trade, and ensuring competition for the producer, who can now, if he wishes, sell his produce direct to a large exporting firm and thus do away with the services of the middleman.

Native Exports from Kenya

Maize.

In 1938 there was a surplus of native maize in the country, and a considerable quantity, amounting to 103,539 bags, was exported. Of this quantity 80,320 bags were graded, and 25,219 were exported to local ports, for which grading is not required. Most of the maize graded was sent direct to the conditioning plant, where it was treated and re-bagged. This was necessary because, when the first consignments were received at the coast, 58 per cent of the total were rejected through being

either in unsound bags, or in bags weighing less than the regulation $2\frac{1}{2}$ lb. porter and shot bag. This large percentage of rejections was therefore mainly the fault of the firms handling the maize for export, in that they did not take the trouble to see that it was put into good bags and properly weighed before loading up-country. The maize was all graded and passed for export after re-bagging. This initial trouble has now almost entirely disappeared.

Potatoes.

The table following gives the destination and quantity in hundredweights of potatoes exported as declared in Customs Export Entries submitted for the years 1936 to 1938 :—

DESTINATION	QUANTITIES IN CWT.		
	1936	1937	1938
	<i>Cwt.</i>	<i>Cwt.</i>	<i>Cwt.</i>
Aden	8,287	3,003	7,389
Bombay	43,796	22,915	79,371
Chisimaio	310	—	—
Cape Town	—	—	200
Colombo	1,278	688	9,580
Calcutta	300	300	160
Dar es Salaam	7,397	8,264	9,447
Hong Kong	—	—	54
Durban	526	—	—
Djibouti	—	—	129
Kilwa	—	—	6
Lindi	669	783	889
Lourenco Marques	1,537	—	14,088
Marmagoa	—	—	920
Mozambique	6,293	6,413	6,488
Mogadiscio	3,839	—	7
Mauritius	4,303	3,778	16,796
Majunga	419	364	554
Mikindani	69	91	81
Merka	398	—	—
Madras	—	—	253
Pangani	—	—	52
Port Amelia	1,332	1,293	1,944
Port Sudan	—	—	100
Porebander	—	—	1,111
Seychelles	—	—	4,600
Tanga	345	658	644
Zanzibar	6,536	7,338	8,704
TOTALS ..	88,878	57,898	163,587

It will be seen that 1938 was a record year for potatoes, there being an increase of 182.5 per cent over the previous year, and almost double the total of 1936, which was the previous record. The table shows that Kenya potatoes are

now used all round the shores of the Indian Ocean. Unfortunately, the prices obtained overseas were not as good as could have been obtained, owing to faulty market organization, and it is to be regretted that it has to be reported that the prices were forced down in certain oversea markets as a result of cut-throat competition between Kenya merchants underselling each other on these markets. The whole question of the marketing of native potatoes is being examined in 1939, and the Department has put certain proposals before the Government for organizing the market for export potatoes, which should ensure fair market value for the native growers.

Beans.

The amount of bean exports from Kenya was also a record, 36,043 bags being exported. Of this amount more than 32,000 were graded either K2 or K3. A small quantity of White Haricot beans were exported, this being the first year in which these beans have been available in quantities large enough for export. It is hoped to add a cleaning and polishing plant to the conditioning plant to give this variety of bean proper treatment before export.

VALUE OF KENYA NATIVE EXPORTS, 1938

	£
Cotton	104,115
Potatoes	38,769
Wattle Bark	29,357
Wattle Extract	61,256
Hides :	£
Sun-dried	45,272
Shade-dried	79,332
	124,604
Skins :	
Sheep, Sun-dried	769
Shade-dried	3,081
Goat Sun-dried	43,327
Shade-dried	14,229
Other	1,446
	62,852
Groundnuts	2,894
Oils, Sesame	10,602
Maize	31,900
Beans	21,960
TOTAL ..£	488,309

Investigation of Overseas Markets for Export Crops

Whilst in England, the Marketing Officer obtained information about the market in Great Britain for beans, ground-nuts, sesame and potatoes. He also investigated the market requirements for hides and skins, and visited Covent Garden to obtain information on the requirements of the London fruit market.

Grading and Inspection (Imports and Exports)

GRAIN CONDITIONING AND COOL STORE SERVICES

This section of the report has been prepared by the Chief Grader and Inspector.

PLANT IMPORT INSPECTION

The table following gives the numbers of packages and the declared value as recorded by this office of the various importations into the Colony through Mombasa only of seeds, plants, fruit, etc., for the years 1936, 1937 and 1938:—

	No. OF PACKAGES			DECLARED VALUE		
	1936	1937	1938	1936	1937	1938
				<i>Sh. cts</i>	<i>Sh. cts.</i>	<i>Sh. cts.</i>
Seeds ..	796	783	711	34,762 47	39,704 56	35,100 53
Fruit ..	26,304	27,921	30,744	260,490 39	263,496 62	308,048 65
Plants ..	236	170	162	6,576 84	6,944 19	7,514 96
Fruit Trees..	137	185	182	6,978 36	15,009 96	12,842 94
Tea Seed ..	309	229	20	12,173 88	21,968 59	800 00
Bulbs ..	200	199	161	32,665 00	11,736 53	6,879 79
TOTAL ..	27,982	29,487	31,980	353,646 94	358,880 45	371,186 87

An increase of 2,503 packages (8.5 per cent) on the figures for the preceding year is shown, together with a slight increase in the declared value.

In addition, 143 packages and 31 packages valued at Sh. 4,320/65 and Sh. 1,005/50 were passed on behalf of Uganda and Tanganyika Territory respectively.

GRADING AND CONDITIONING SERVICES

Maize for the 1937-38 season's crop had commenced to arrive at the coast in December, 1937. Grading was continuous throughout the year.

In the annual report for 1936 it was noted that 58,700 bags of native-grown maize were graded. Owing to the high internal prices during the latter part of 1937, no native maize was received; during 1938 there has been a revival in the export of native maize. It is considered advisable for the purposes of record and comparison to tabulate maize from European and native sources separately, and that procedure will, as far as possible, be followed in this report.

(a) Maize Submitted Direct for Grading at the Coast and Kitale (European Grown)

A total of 492,317 bags of maize was submitted for grading. The table following gives the grades, number of bags and relative percentage of the total received, with comparative percentage of grades for the previous year:—

GRADE	Number of Bags	Percentage of Total Received	Comparative Percentage for 1937
		<i>Per cent</i>	<i>Per cent</i>
K2	195,092	39.63	38.09
K2 SW	30,813	6.26	15.16
K3	153,025	31.08	18.38
K3 SW	35,724	7.25	9.43
K8 W	14,589	2.96	.48
K8 W SW	5,766	1.17	.63
Total Graded	435,009	88.36	83.01
Rejected :			
Wet	32,407	6.58	7.55
Musty	954	.19	.03
Weevily	17,808	3.61	9.00
Other Causes	6,139	1.25	.38
Total Rejected	57,308	11.64	17.00
Total Received	492,317	100.00	100.00

The total received, viz., 492,317 bags, is an increase of 65,668 bags (15.39 per cent) compared with the previous year's figures of 426,649 bags.

The decline in the standard and quality of maize graded reported in 1936 and 1937 is again evidenced by the low percentage graded K2 (39.63 per cent), as compared with 38.9 per cent in the previous year. Slightly weevily and weevily maize showed a satisfactory reduction, but to counteract this the percentage of maize graded K3 was very high.

Included in the foregoing table are 168,282 bags of maize graded at Kitale. Particulars of this latter maize are given in the following table and for comparative purposes European-grown maize submitted direct for grading at the coast is given also:—

GRADE	KITALE			COAST		
	Number of Bags	Percentage of Total Received		Number of Bags	Percentage of Total Received	
		1938	1937		1938	1937
K2	71,965	42.77	40.75	123,127	38.0	37.56
K2 SW	15,094	8.97	16.8	15,719	4.85	13.99
K3	43,273	25.71	16.14	109,752	33.87	20.05
K3 SW	15,314	9.10	9.18	20,410	6.29	9.61
K8 W	3,258	1.93	0.55	11,331	3.49	0.42
K8 W SW ..	2,354	1.39	0.49	3,412	1.05	0.74
Total Graded ..	151,258	89.88	83.93	283,751	87.56	82.36
Rejected—						
Wet	9,177	5.45	5.19	23,230	7.17	9.24
Musty	93	0.05	0.04	861	0.26	0.03
Weevily	6,939	4.12	10.0	10,869	3.35	8.30
Other Causes ..	815	0.48	0.82	5,324	1.64	0.07
Total Rejected ..	17,024	10.12	16.07	40,284	12.43	17.64
TOTAL RECEIVED ..	168,282	100.00	100.00	324,035	100.00	100.00

Wet Maize.

The following table gives the sending station and the average moisture content of maize rejected as wet at the coast and Kitale:—

STATION	Number of Bags	Average Moisture Content
		<i>Per cent</i>
Broderick Falls	310	15.4
Butere	39	14.6
Hoey's Bridge	2,384	14.3
Kitale	9,177	14.3
Kitale, Mile 33½	33	14.0
Kampi-ya-Moto	1,513	15.0
Karatina	226	14.0
Lugari	11	14.6
Luanda	561	14.8
Menengai	930	14.3
Njoro	620	14.3
Nakuru	2,171	14.5
Ol Punyata	1,923	15.2
Rongai	7,344	14.8
Sabatia	2,151	14.2
Sagana	249	14.2
Solai	510	15.0
Turbo	1,068	14.2
Yala	527	14.3
Wet by Rain	2,521	—

Wet maize consigned direct to the Maize Conditioning Plant is not included in the above table.

*(b) Maize Graded at the Conditioning Plant after Treatment
(European Grown)*

GRADE	Number of Bags	Percentage of Total
		<i>Per cent</i>
K2	22,727	49.6
K3	17,920	39.12
K3 C	2,899	6.32
K8 W C	2,267	4.95
TOTAL GRADED, TOTAL RECEIVED ..	45,813	—

The letter "C" following the grade indicates "treated by heat for the destruction of weevils".

The K3C and K8C maize was railed from Kitale and Hoey's Bridge in July and was found on arrival to be very weevily.

(c) Maize Re-graded

5,795 bags of maize were re-graded. Re-grading was caused by the maize being bagged in unsatisfactory containers.

(d) Native-grown Maize

The following table gives the particulars of native-grown maize submitted direct for grading:—

GRADE						Number of Bags	Percentage of Total
K3	..	..	..	..	..	3,823	<i>Per cent</i> 10.92
K3 SW	..	..	..	..	..	1,162	3.32
K8 W	..	..	..	..	..	5,023	14.34
K8 W SW	..	..	..	..	..	1,785	5.1
TOTAL GRADED ..						11,793	33.69
Rejected :							
Wet	..	..	..	..	..	1,663	4.75
Musty	..	..	..	..	..	206	0.58
Weevily	..	..	..	..	..	816	2.33
Other Causes	..	..	..	..	..	20,534	58.62
						23,219	66.31
TOTAL RECEIVED ..						35,012	100.0

The above table is not indicative of the standard and quality of the native-grown maize submitted direct for grading, owing to the very high percentage, viz., 58.62 per cent rejected for "other causes". This rejected maize was shipped to local ports.

The reasons for rejection under this heading were:—

- (a) *Undergrade Bags*.—Even when new bags were used, they did not comply with regulations, being $2\frac{1}{2}$ lb. bags.
- (b) *Unsound and Unmerchantable Bags*.—Many consignments were received in bags which could only be described as "in shocking condition".
- (c) *Underweight*.—Regulations prescribe 200 lb. net weight per bag. Weights varied from 195 lb. to 202 lb. gross.

The origin of the 35,012 bags of maize was as follows:—

Nyanza	16,949 bags
Central Province	12,679 bags
Coast (Malindi)	4,679 bags
Other stations	705 bags

*Maize Graded at the Conditioning Plant after Treatment
(Native-grown)*

68,537 bags of native-grown maize were graded after treatment at the Conditioning Plant.

The table following gives particulars and origin of this maize:—

ORIGIN	K2	K3	K3C	K8	K8C	Total Graded	Total Received
Nyanza ..	—	19,099	545	1,997	277	21,918	21,918
Central Province ..	274	3,901	—	17,770	7,321	29,266	29,266
Central Province (Athi River) ..	—	11,846	850	779	—	13,475	13,475
Other Stations	—	1,081	108	978	1,711	3,878	3,878
TOTALS ..	274	35,927	1,503	21,524	9,309	68,537	68,537

The quality of maize from Nyanza remains a good quality K3, and the same remark applies to maize from the Machakos area raised from Athi River. Apart from this latter maize, Central Province, generally speaking, was of poor quality owing to undeveloped grain and weevil damage.

The early appearance of heavy weevil infestation in all maize from native areas presents a serious problem. All native-grown maize consigned to the Conditioning Plant showed weevil infestation, although no apparent damage, in most cases, had been done to the maize.

Total Maize Graded from all Sources

The total number of bags of maize graded from all sources was 647,474 bags, an increase of 150,423 bags, representing a percentage increase of 32.63 per cent over the previous year's figures of 497,051 bags.

Shipments

One hundred and twenty-one export certificates in respect of 532,863 bags of maize were issued, as shown in the table following:—

Number of Certificates	Number of Bags	Description
13	49,808	K2 (Second Grade.)
11	170,765	K2 (Second Grade) (shipped in bulk).
2	3,272	K2 SW Second Grade. Slightly weevily.
6	27,578	K2 SW Second Grade. Slightly weevily. (Shipped in bulk.)
34	65,659	K3 Third Grade.
12	142,560	K3 Third Grade (shipped in bulk).
1	859	K3 SW Third Grade. Slightly weevily.
6	34,668	K3 SW Third Grade. Slightly weevily. (Shipped in bulk.)
3	3,745	K3 C Third Grade. Treated by heat for the destruction of weevils.
23	27,196	K8 W Undergrade.
2	560	K8 W SW Undergrade. Slightly weevily.
8	8,193	K8 W C Undergrade. Treated by heat for the destruction of weevils.

375,571 bags, or 70 per cent, of the maize described above was "shipped in bulk".

Inspection Certificates.—17,301 bags were shipped on certificate.

Local Shipments.—As permitted under Rule 25 of the Grading of Maize Rules, 64,839 bags of maize were shipped to ports north of Beira, south of Port Said and the coast of Arabia, without certificates and/or inspection. The total shipped is an increase of 27,931 bags (75.67 per cent) over the previous year's total of 36,908 bags.

CONDITIONING PLANT, KILINDINI

(a) *Maize.*—A total of 116,273 bags of maize was treated, of which 76,177 bags were accepted consigned direct to the Plant, an increase of 48,173 bags over the preceding year.

(b) *Beans.*—36,594 bags of beans were treated for the destruction of bean beetle, as compared with 4,327 bags in 1937.

(c) *General.*—Considerable work on maintenance and repairs was carried out on the Conditioning Plant building by the Public Works Department during the year.

It will be appreciated from the quantities of maize and beans treated at the Conditioning Plant that work was fully maintained throughout the year.

Grading of Potatoes

163,637 cwt. of potatoes were submitted for grading and classified as follows:—

K1	...	...	...	...	3,366 cwt.
K2	...	...	...	...	160,058 cwt.
Seed	...	...	...	...	201 cwt.
Rejected	...	...	...	...	12 cwt.

The total submitted for grading, viz. 163,637 cwt., is a record, being an increase of 182.5 per cent over the figures for the preceding year (57,922 cwt.). The previous highest total submitted for grading was 89,763 cwt. in 1936.

Quality throughout the year has been high.

Ships' Stores.—Export entries for 5,459 bags of potatoes, estimated to weigh 9,262 cwt., were passed. The figures for the preceding year were 5,259 bags estimated at 8,967 cwt.

Grading of Beans

The following table gives the varieties, quantities in bags, and grades of beans submitted for grading:—

VARIETY	K2	K3	K4	Total Graded	Total Received
	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>
Rose Coco	5,377	22,875	3,710	31,962	31,962
Canadian Wonder ..	966	1,991	—	2,937	2,957
Madagascar Butter Beans	477	—	—	477	477
White Haricot.. ..	273	282	92	647	647
TOTAL ..	7,093	25,148	3,802	36,043	36,043

Whilst the general appearance and quality was up to normal, the prevalence of beetle-damaged beans was the cause for beans being graded K3 and K5. No mixed beans (K4) were submitted for grading.

The total submitted for grading, 36,043 bags, constitutes a record since beans were brought under the Agricultural Produce Export Ordinance.

In addition, 1,035 bags of beans intended for seed purposes in the United Kingdom were exported; these beans were either conditioned or fumigated prior to export.

COOL STORES

Comparative table of commodities stored during the last five years:—

COMMODITY	Unit	1934	1935	1936	1937	1938
Fruit	lb.	276,969	191,657	241,210	274,501	231,823
Fresh Fish ..	„	20,914	9,195	30,007	8,232	5,930
Cured Fish ..	„	40,839	48,427	50,416	44,598	39,492
Cheese	„	11,422	10,328	9,638	9,318	14,034
Offal	„	3,991	4,577	3,581	8,313	7,450
Poultry	Doz.	59	184	114	436	230
Butter	Cases	3,783	8,278	15,582	10,451	3,564
Beef	lb.	49,519	45,285	71,877	99,137	135,752
Mutton & Pork	„	31,273	39,997	36,678	53,109	71,097
Eggs	Doz.	3,225	7,925	11,310	11,280	16,800
Bacon and Ham	lb.	756	500	1,321	2,982	2,136
Vegetables ..	„	2,949	2,787	736	6,815	2,157
Yeast	„	645	212	544	523	286
Miscellaneous (Game)	„	..	..	..	4,384	3,621

Note.—A small number of miscellaneous articles is stored each year which does not warrant inclusion in the above table.

As in the previous year, it was necessary on occasions to refuse the acceptance of commodities into store on account of lack of space. The principal sufferers were importers of fruit and exporters of eggs and butter.

All machinery units were overhauled during the year.

ACKNOWLEDGMENTS

During the writer's absence on leave, the section was in charge of Mr. P. V. M. Quiggin, Grader and Inspector. Owing to leave movements, and the untimely death of Mr. Megson, this officer and the remainder of the staff had a very difficult time, and the work appears to have been carried out in a satisfactory manner in spite of the difficulties owing to lack of staff and sickness which had to be overcome.

The Department's thanks are due to the Railway Administration and the Port Staff for their continued co-operation and assistance.

PART III

Summary of the More Important Legislative Changes Affecting Agricultural Industries in 1938

Sugar

The Sugar (Control) Ordinance, 1938, was enacted to give effect to the International Sugar Agreement which was signed in London on the 6th May, 1937.

Power is given to the Governor in Council to fix the quota of sugar that may be exported from the Colony and to allocate it amongst the sugar manufacturers. No person may export sugar except under a licence from the Director of Agriculture. The Governor may declare that the total stocks of sugar during a specified period shall not exceed a fixed amount, and may require manufacturers to submit returns of sugar manufactured and held in storage.

The Ordinance remains in force until 31st August, 1942, but the period may be extended by proclamation.

Pyrethrum

The Pyrethrum Ordinance, 1938, was introduced at the request of the Advisory Board to the Agency appointed under the Sale of Pyrethrum Ordinance, 1935, and re-enacts with minor amendments the provisions of the earlier Ordinance, and provides a further measure of control over the industry.

A statutory Board is set up, composed of two members appointed by the Governor and three persons elected at an annual conference of growers, which will largely control and regulate the industry. The Ordinance also establishes a Pyrethrum Levy Fund, financed by growers' annual licence fees of Sh. 50 and by a levy of all pyrethrum sold, which is administered by the Board.

Tea

In view of the continuance of the International Tea Restriction Scheme for a further five-year period, it was necessary to make provision for the grant of licences to plant tea to the extent of the additional acreage available to Kenya for this period. The Tea (Amendment) Ordinance, 1938, was accordingly promulgated.

The original Ordinance provided that the total area of land in the Colony for which licences to plant may be issued

shall not exceed 1,000 acres, and licences for this area were granted during the first restriction period. The amending Ordinance allows of the planting of a total area of 3,300 acres within the restriction period.

By an order under the Customs Management Ordinance the export of tea to territories outside Uganda and Tanganyika is prohibited except under licence.

Advances to Farmers

The Agricultural Advances (Amendment) Ordinance, 1938, provides that, with effect from 1st January, 1938, no further interest shall be charged on advances made before that date, and no interest shall be charged on advances made after that date.

Agricultural Mortgagors' Relief

Proclamation No. 102 of 1938 provides for the Agricultural Mortgagors' Relief Ordinance, 1934, to continue in force till 31st December, 1941.

Cotton

The Kenya Cotton (Amendment) Rules, 1938, were brought into force on 6th June, 1938, and include a number of minor amendments to the Principal Rules.

Passion Fruit

The Passion Fruit Rules, 1938, require every registered grower, within ten days after registration, to forward to the Agency a notification of such registration. The grower must render to the Agency when required a return showing particulars of passion fruit under cultivation and other particulars. Factories for the preparation of passion fruit products may not be operated without permission from the Board.

Sisal

Proclamation No. 110 of 1938 provides for the Sisal Industry Ordinance, 1934, to continue in force till 31st December, 1943.

Wheat

The Sale of Wheat (Agency) (Amendment) Rules, 1938, alter the dates on which the Agency has to submit returns from 1st April to 1st October to 1st March and 1st September.

Coffee

The Diseases of Plants Prevention (Coffee) (Amendment) Rules, 1938, permit the importation, without the necessity of first obtaining a permit, of coffee beans imported into the Colony in bond for trade purposes from Tanganyika, Uganda, and the Belgian Congo.

Plant Protection

An order under the Plant Protection Ordinance, 1937, prohibits the importation into the Colony of any rooting medium for plants which consists either wholly or in part of soil; fruit grown in countries other than Zanzibar, Tanganyika and Uganda may not enter the Colony unless accompanied by a certificate to the effect that a percentage has been examined and found to be free of insect pests; a permit is now required for the importation of seed of barberry and blackthorn.

Improvement and Inspection of Native Produce and Stock

(Crop Production and Live Stock Ordinance, 1926)

The following Rules dealing with the improvement and inspection of native produce and stock were gazetted during the year:—

Cashew Nut Marketing (Amendment) Rules, 1938.

Crop Production and Live Stock (Amendment) Rules, 1938.

Crop Production and Live Stock (Amendment No. 2) Rules, 1938.

Culling of Cattle Rules, 1938.

Maize Inspection (European Areas) (Amendment) Rules, 1938.

Native Grown Coffee (Amendment) Rules, 1938.

Native Produce Improvement and Inspection (Amendment) Rules, 1938.

Native Produce Improvement and Inspection (Amendment No. 2) Rules, 1938.

Wattle Bark Factory Rules, 1938.

Publications

East African Agricultural Journal

The following articles were written by members of the Department:—

VOL. III, No. 4—

“Farm Fencing, III,” by L. A. Elmer.

“An Analysis of the Kenya Agricultural Census of 1938,” by V. Liversage.

“Pasture Problems in the Trans Nzoia,” by M. Halcrow.

VOL. III, No. 5—

“Farm Fencing, IV,” by L. A. Elmer.

VOL. III, No. 6—

“Kenya Coffee Mealy Bug Research,” by A. R. Melville.

“Farm Fencing, V,” by L. A. Elmer.

“The Valuation of Manures and Fertilizers,” by G. H. Gethin Jones.

VOL. IV, No. 1—

“Cotton Research at Barberton,” by E. W. Gaddum.

“Growing of Wattle and Production of Wattle Bark in Kenya,” by W. G. Leckie.

VOL. IV, No. 2—

“Stock in an Alternate Husbandry Farming System,” by R. S. Ball.

“Food Crops and Food Shortage,” by N. Humphrey.

VOL. IV, No. 3—

“The Appearance of a New Physiologic Form of Stem Rust in Kenya Colony,” by R. J. Lathbury.

“Some Observations on Farming Economics in the Nakuru District,” by V. Liversage.

“The Sunflower,” by L. A. Elmer.

Monthly Bulletin of the Coffee Board of Kenya

VOL. IV, No. 37—

“The Valuation of Manures and Fertilizers,” by G. H. Gethin Jones.

VOL. IV, No. 38—

“Notes on the Manuring of Coffee,” by G. H. Gethin Jones.

Report on Banding Grease Trials.

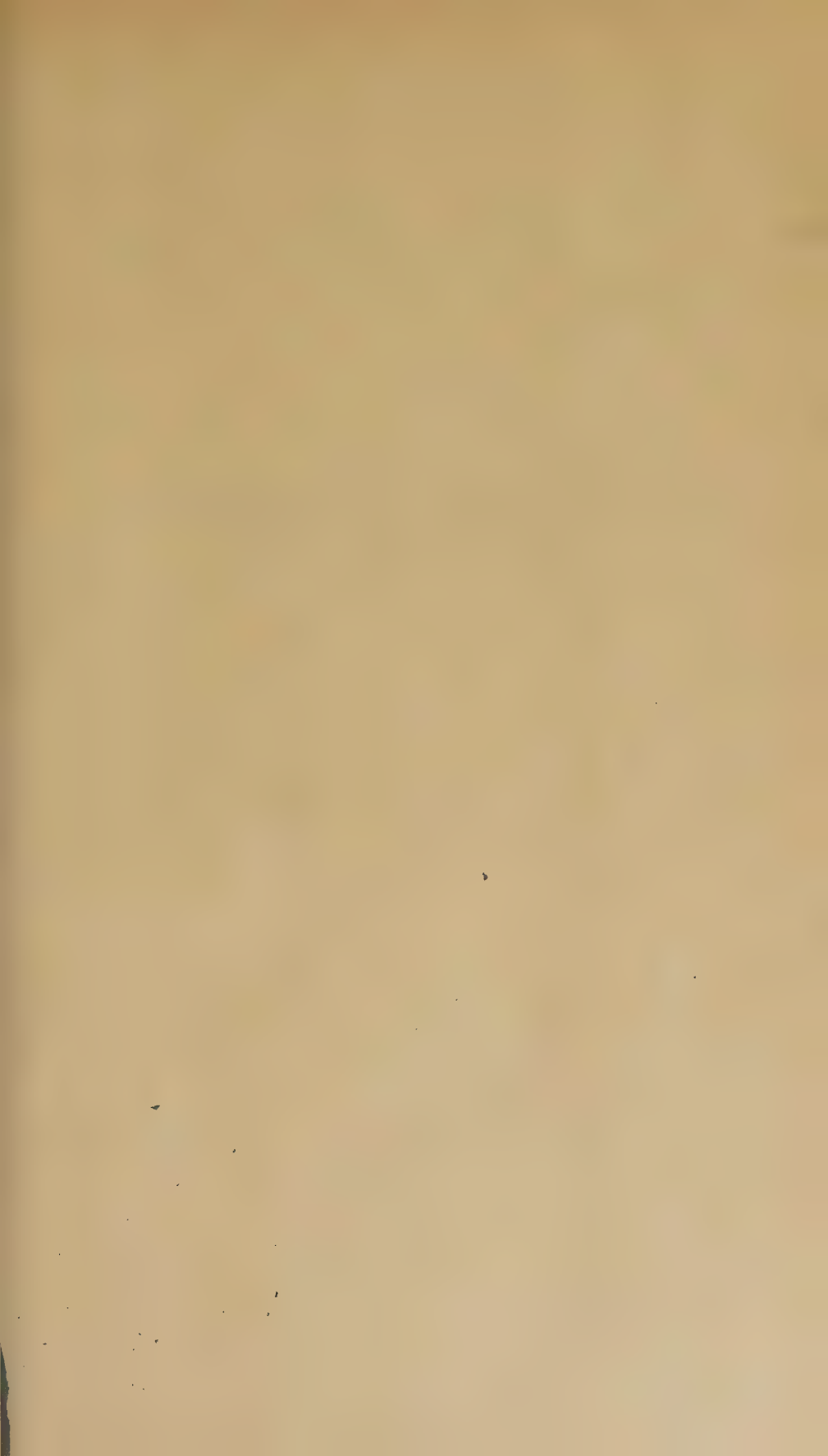
VOL. IV, No. 48—

Report on Banding Grease Trials.

Pollution of Streams by Coffee Effluent.

In addition, a number of articles have been published in technical journals, and short notes and articles in the local Press.

H. B. WATERS,
Director of Agriculture.



DEPARTMENT OF AGRICULTURE
ANNUAL REPORT, 1938

Volume II

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ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, 1938

Volume II

PART IV—COFFEE TEAM SERVICES

Introduction

In the introduction to last year's report of the Coffee Team the investigations in the Eastern area were discussed separately from those in the Western area and the same plan will be followed this year. As the Annual Report is called for at the end of the calendar year and the season's picking and the calculations consequent thereon are not completed until some months later, the reports on some investigations are some nine months behindhand.

EASTERN AREA

This includes the Scott Agricultural Laboratories, the Thika and the Makuyu Experiment Stations, and the co-operative work done on plantations throughout the area. The altitude ranges from 4,800 feet to 6,200 feet, and there are two sharply divided rainy seasons.

Mealy Bug

A very great advance has been made during the year. Mr. Melville went to Uganda and confirmed the existence of *Pseudococcus kenyae* as a minor pest, both there and in an adjoining part of Tanganyika, despite the presence of the attendant ant, *Pheidole punctulata*. Furthermore, Mr. Melville found and sent to Kenya a number of species of primary parasites of the mealy bug. These are not found in the Central Province of Kenya, but are responsible for reducing *Pseudococcus kenyae* to the status of a minor pest in Uganda. There is no reason as yet to believe that they will not be equally effective in Kenya. These were all successfully reared at the Scott Laboratories by Dr. le Pelley and his assistant, Mr. Naismith Jones, and later with the assistance of Mrs. le Pelley also. By the end of the year four species

had been produced in the Quarantine Laboratory in sufficient numbers for liberation in the field and three others were being worked upon. All concerned are to be congratulated on the initiation and subsequent conduct of this work, which bids fair to rank amongst the best work of its kind. Its ultimate success depends on how well the parasites breed in the field when liberated. An interim report on the work has been published in the *East African Agricultural Journal*.

Mr. Melville considers the area in Uganda and Tanganyika Territory in which he found *Pseudococcus kenyae* to be an ecological island bounded by distinct natural barriers, as is the Central Province of Kenya.

Cultural Work

Further areas of coffee for experimental work have been planted at the Scott Agricultural Laboratories and the work at this station is rapidly developing on sound lines. The sub-stations at Thika and Makuyu are also developing satisfactorily, and will play an important role in the cultural investigational programme in the near future. The co-operative experiments on estates are also going well and thanks are due to the many owners and managers concerned for their personal assistance. The co-operative experiments include manuring, spraying, shade trees, variety and pruning trials. Much of the selection work, consisting largely of individual tree recording, is done on estates as well as on the stations and several thousand trees are being recorded for selection, uniformity and quality trials in the following sub-districts: Kiambu, Kabete, Ruiru, Thika, Donyo Sabuk, Makuyu, Nyeri and Solai; it is too early as yet for results to be published, but it would appear that, whilst the number of really high-yielding trees is low, the number of uneconomic trees on the average plantation is high.

The experiments at the new Thika and Makuyu sub-stations are in too early a stage to give any results, and this is also the case with a large number of the experiments at the Scott Agricultural Laboratories. Attention may, however, be drawn to some of them. The block pruned on the multiple stem system is still yielding as highly as the single stem coffee. This experiment has been augmented by one designed for statistical interpretation comparing the two systems and this again has been supplemented by another

comparing several systems of single stem pruning with multiple stem. Crop recording on these experiments will begin next season. The Bordeaux spraying experiment still gives results in yield heavily in favour of Bordeaux spraying. The drought experienced during the year showed this treatment up well. Experiments with fog spraying are being continued. Trials of shade trees and shade are being extended throughout the Eastern area.

The committee consisting of some of the Upper Kiambu planters and members of the Coffee Team are to be congratulated on the results of the investigation into the cause of what has been known as the Upper Kiambu "taint" in liquor from certain estates at the higher altitudes. In conjunction with the Liquoring Department of the Coffee Board, investigations were made into the effect on liquor of factors in connexion with coffee growing which are peculiar to the higher altitudes. None of the factors investigated, however, appeared responsible. However, the "taint" or strong flavour had in the previous year been confined almost entirely to the higher altitudes, but during this year it was also found occasionally at lower altitudes. A careful survey of all the estates by Mr. Gillett suggested to him that the flavour might be bound up with too high a leaf to crop ratio—a condition usually associated with the higher altitudes. Liquoring tests, both with blocks of coffee and individual trees in different states of leaf to crop ratio, showed that this was invariably the case. This has been confirmed by liquorers in London, as also the effect the flavour has on prices. Further investigations will be conducted next year, together with individual tree recording of specially pruned and handled trees, and a full report issued. Mr. Gillett is greatly to be congratulated on this work. It may well be the explanation of the prevalent idea that Bordeaux spraying and even over-manuring with organic manures are detrimental to flavour. The large number of experiments with new pruning systems now being conducted by the Coffee Team and planters may have an important bearing on the practical control of the leaf/crop ratio.

Vegetative Propagation

The preliminary field grafting experiments were completed by the end of the year. These showed that November was the best month for grafting, with May as the next best

month. These experiments, spread over a large number of estates in the Eastern area, are to be followed up by experiments done in more detail on four estates typical of the various conditions of the area. It appears likely that top-working of plantations may be embarked upon with some certainty of success in the not very distant future. Attention is drawn to Mr. Jackson's new technique for the use of growth substances in rooting cuttings.

White Borer

The white borer campaigns in the Makuyu district were successfully conducted during the year and thanks are due to the willing help and co-operation of the planters of the district.

WESTERN AREA

The work is concentrated at Kepchomo Estate, Nandi, with a sub-station at Sotik, at the Kitale Experiment Station, at Kapretwa Estate, Mount Elgon, and also in the form of co-operative experiments on estates. The work is largely concerned with "Hot and Cold", Coffee Berry Disease, Elgon Dieback and Leaf Disease.

Coffee Berry Disease

At the Kepchomo Experiment Station, Nandi, tests of new colloidal copper sprays were conducted during the year. Also tests were made of spraying before and after flowering as against spraying after flowering and again a few weeks later. Four trees were also sprayed each month to record the incidence of Coffee Berry Disease. It has, however, been difficult to gauge results from these spraying experiments, since there has been very little crop either on the controls or on the sprayed trees. At the Sotik Station, where there are a number of varieties undergoing tests for resistance to Coffee Berry Disease (both for trees propagated vegetatively and from seed) a number of individual trees and blocks of coffee varieties are being recorded for yield. This is the best means of testing for resistance. In the Nandi district some fifty-six trees have been selected as being at least moderately resistant, and are now being individually recorded, as well as several surrounding trees in each case, in order to test their resistance to the disease.

Lack of flowering, and thus of crop, under the very difficult conditions of coffee-growing experienced at Kepchomo Estate, is likely to make conclusive results on resistance to the disease, or on the effect of spraying, difficult to obtain. This does not apply at the Sotik Station, and we await the results of the first crop records now being made to see just how comparatively resistant the Blue Mountain variety is and the yield which may be expected from it. Complementary studies on Coffee Berry Disease are also made at the Kitale and Kapretwa Stations.

Elgon Dieback

Further investigations have been made at the Mount Elgon Station into the cause of Elgon Dieback, but the beneficial effects of shade, or the use of a resistant variety of coffee, are still apparent, and these still remain satisfactory methods of control. Further selection work of individually resistant trees has been done and the crop continues to be recorded from many of these trees to see whether they yield well and give good quality coffee. Observation trials of individual shade trees are being continued as well as comparative tests of blocks of different shade trees over susceptible coffee. The studies which have been continued on the best method of cultivating coffee vegetatively will have an important bearing on the successful propagation of resistant varieties in established plantations.

Our best thanks are due to Mr. Jackson, who owns Kapretwa Estate, for his invaluable co-operation in the past and for his promise of more in the future.

No detailed report on the work of Kapretwa Estate appears in this Annual Report, but Mr. Thorold, the Plant Pathologist concerned, is writing up the results of the past four years' work in bulletin form.

Leaf Disease

Four trees selected for resistance are now under observation and record on Mr. Walker's estate at Muhoroni. The two original selections have been prepared for the production of suckers, and a number of these are now being taken and grafted on to other root stocks in the districts where Leaf Disease is prevalent. This material is being multiplied up as rapidly as possible.

The value of sprays is still being investigated, as is the role copper plays in averting loss from this disease. The value of applications of ammonia sulphate is being compared with that of copper also.

"Hot and Cold"

Work on this problem is directed towards the use of shade, in which connexion shade trees and blocks of shade are under trial throughout the area. The other line of attack is through the "resistant" variety. Those types with an open habit of growth, resistant to Elgon Dieback, appear to be those most resistant to "Hot and Cold" also.

Cultural Work, Pruning, Vegetative Propagation, Variety Trials and Trials of Shade

The simplification of pruning obtainable under the multiple stem system is most necessary for the Western area, where growth is so rapid, and much of the experimental work is therefore devoted to finding the best system of converting existing single stem trees to the multiple system. Also, since the success of coffee growing in the Western area depends so much on growing the right variety, not only is this being sought through individual tree recording and variety trials, but the best way of substituting it in existing plantations is also being investigated. Grafting and inarching are therefore receiving special attention and the immediate and ultimate merits of the two methods are also being compared. Different ways of renovating plantations with new seedling material are also under trial. The rooting of cuttings under Western area conditions is also being investigated. Vegetative propagation is on the whole easier in the Western than the Eastern area. Variety and type trials on the standard plan are being conducted at the four main centres and this work holds great promise in an area where the need for another type is so obvious. The search for new types is made by means of recording individual trees which show promise of suiting the conditions better. A staff of trained Africans is used for this work, most of which is done in co-operation with planters. Trials with natural shade are second to none in importance in this area; numbers of temporary and permanent shade trees, as well as blocks of shade trees, are under trial on the stations and in co-operation with planters throughout the area.

Quality in the Western Area

The peculiar flavour of coffee in the Trans Nzoia was under investigation, with particular reference to the effect of possibly faulty factory methods. A systematic investigation of the effect of various factory treatments showed that the flavour could not be ascribed to any such causes. It is possible that, the altitude being 6,000 feet or over, the cause of the flavour is bound up with the high leaf/crop ratio prevalent in the higher regions of the Western area—*vide* the Upper Kiambu flavour.

SPECIAL INVESTIGATIONS

Chemical and Biochemical Work

The investigations done in collaboration with the Public Works Department into the pollution of streams with coffee factory effluents were completed and recommendations have been made in the local press for prevention of pollution.

Valuable work on the potash supplies in the main coffee soils in the Eastern area showed that there was no lack of potash and that potassic fertilizers need not be used.

It had been rumoured from Brazil that specific or general micro-flora taken from fermenting tanks in which good or bad quality coffee had been fermented would alter the quality of coffee if sprayed on the cherries whilst still on the trees. A careful investigation showed that this was not the case, but during the course of the investigations Mr. Gethin-Jones came to some valuable conclusions on the subject of the value of liquoring reports and the ability of liquorers to detect quality. These views will be found in his report and they suggest that variation in reports was due to variation in cup rather than to any failure of the liquorer. He also stresses the importance of eliminating undesirable beans.

Meteorological

Meteorological screens were erected at all the principal sub-stations during the year. In addition to general climatological studies of the several areas, specific studies are being made in connexion with the incidence of Coffee Berry Disease and the Upper Kiambu characteristic flavour.

The tabulated records below give an interesting summary of the variations that occur in climate in the main coffee-growing areas:

RAINFALL RECORDS FOR 1938

	Scott Agric. Lab.	Karimani, Thika	North Kikito, Makuyu	Kibubuti, Kiambu	Agric. Dept., Kitale	Kepchomo, Nandi
January ..	0.88	1.48	—	0.21*	1.58	—
February ..	1.33	1.92	1.29	1.32	0.02	1.30
March ..	4.64	2.97	2.46	5.70	1.96	4.08
April ..	5.77	5.29	6.30	5.53	3.41	5.51
May ..	3.78	3.93	2.79	4.20	6.56	5.48
June ..	0.29	0.74	0.04	0.98	4.77	6.71
July ..	0.43	0.51	0.06	0.88	7.92	8.48
August ..	0.39	1.14	0.28	2.39	7.77	—
September ..	0.91	0.61	0.17	1.14	6.84	—
October ..	1.62	3.99	4.06	3.80	2.53	—
November ..	5.18	8.00	11.34	6.97	0.75	1.71
December ..	5.47	6.63	7.42	5.14	1.83	1.72
Total ..	30.69	37.21	36.21†	38.26	45.94	34.99‡
Average Monthly Fall ..	2.56	3.10	3.29†	3.19	3.83	4.37‡
Number of Days on which Rain Fell ..	108	100	67†	152	165	85‡

*Recorded only from 14th January. †11 months. ‡8 months.

SUNSHINE RECORDS FOR 1938

MONTH	Scott Agricul- tural Lab.	Karimani, Thika	Kibubuti, Kiambu	Agricul- tural Dept., Kitale
	<i>Hours</i>	<i>Hours</i>	<i>Hours</i>	<i>Hours</i>
January	258/40	—	—	—
February	247/40	—	—	—
March	235/10	—	—	—
April	200/05	—	—	—
May	154/30	—	—	—
June	108/50	—	—	—
July	91/15	—	—	—
August	120/55	—	69/50	—
September	133/15	—	107/30	—
October	174/00	140/30	145/00	168/00
November	162/35	129/55	138/40	182/34
December	196/40	156/40	169/30	164/25
Total	2,083/35	427/05	630/30	515/10
Monthly Average	173/38	142/22*	126/06†	171/43*

*Three months. †Five months.

MAXIMUM AND MINIMUM

	AVERAGE MAXIMUM						AVERAGE MINIMUM					
	Scott Agric. Lab.	Karimani, Thika	North Kikito, Makuyu	Kibubuti, Kiambu	Agric. Dept., Kitale	Kepchomo, Nandi	Scott Agric. Lab.	Karimani, Thika	North Kikito, Makuyu	Kibubuti, Kiambu	Agric. Dept., Kitale	Kepchomo, Nandi
January ..	77-35	90-02	—	72-55	79-44	—	51-44	54-05	—	51-40	51-60	—
February ..	80-31	94-29	92-98	75-00	82-17	79-33	52-95	54-27	57-13	52-68	51-92	55-00
March ..	81-40	94-67	94-17	74-87	80-36	76-58	55-89	57-27	59-33	53-23	54-61	53-29
April ..	75-80	90-47	89-10	70-19	80-40	75-07	56-52	58-58	60-28	54-94	55-07	55-40
May ..	74-49	87-52	86-87	67-87	75-09	71-48	51-02	57-11	57-57	52-81	54-26	54-03
June ..	71-50	84-12	84-48	65-30	73-07	70-00	51-12	54-02	54-49	48-60	54-60	52-97
July ..	70-06	83-29	84-41	64-74	72-90	69-09	50-32	52-40	53-20	47-97	52-87	52-48
August ..	71-85	85-48	84-73	65-29	73-03	—	50-09	55-20	53-62	48-00	52-42	—
September ..	76-03	89-08	88-14	68-87	75-20	—	51-76	52-84	55-05	49-00	52-17	—
October ..	77-19	92-19	90-54	70-90	77-35	—	53-37	55-23	56-96	51-58	51-61	—
November..	73-69	87-61	86-37	68-43	78-13	75-03	54-55	56-41	56-90	52-77	48-92	55-47
December ..	72-56	87-32	85-29	68-19	77-19	76-97	54-75	56-52	58-49	52-61	50-52	55-19

MEAN DIURNAL VARIATION

	Scott Agric. Lab.	Karimani, Thika	North Kitito, Makuyu	Kibubuti, Kiambu	Agric. Dept., Kitale	Kepehomo, Nandi
January ..	25.91	35.97	—	21.15	27.84	—
February ..	27.96	40.02	35.85	22.32	30.25	24.33
March ..	25.51	37.40	34.84	21.64	25.75	23.29
April ..	19.28	31.89	28.82	15.25	25.33	19.67
May ..	23.47	30.41	29.30	15.06	20.83	17.45
June ..	20.38	30.10	29.99	17.20	18.47	17.03
July ..	19.74	30.89	31.21	16.77	20.03	16.61
August ..	21.81	32.28	31.11	17.29	20.61	—
September ..	24.27	36.24	33.09	19.87	23.03	—
October ..	23.82	36.96	33.58	19.32	25.74	—
November ..	19.14	31.20	29.47	15.66	29.20	19.56
December ..	17.81	31.40	26.80	15.58	26.67	21.78

ACKNOWLEDGMENTS

Coffee Team

The Coffee Team was at full strength during the year, with the exceptions that I was Acting Deputy Director for the last six months of the year and Mr. McClelland was on leave for the first six months. The relief staff was able to cope with the situation and a unit was also posted to the Kitale Experimental Station to look after the coffee work there and in the district. Adequate staff and adequate money for travelling has greatly strengthened the research and advisory services, as has the whole-hearted support of coffee planters, both morally and in the form of practical assistance with co-operative work on their plantations. The Coffee Board and the research committee of the Board has also backed up and helped in the work. Lastly, this report would not be complete without a tribute to Mr. Devonshire, the Coffee Board's liquorer. It is not too much to say that he is very nearly a member of the Coffee Team. In spite of plenty of work in connexion with his normal duties, he has never failed to liquor and report upon each of the hundreds of, often difficult, samples submitted to him by the Coffee Team.

G. J. L. BURTON,

Senior Plant Breeder and Experimentalist.

The Scott Agricultural Laboratories

INVESTIGATIONAL WORK ON COFFEE

Rainfall

The rainfall recorded at the Scott Agricultural Laboratories for the year was 30.69 inches. This was 28.11 inches less than last year's rainfall and also 7.72 inches less than the average for the past thirteen years.

MONTHLY RAINFALL—SCOTT LABORATORIES

MONTH	Inches	Average Monthly Rainfall Over 13 Years
January	0.88	1.76
February	1.33	1.08
March	4.64	5.03
April	5.77	8.38
May	3.78	6.88
June	0.29	1.64
July	0.43	0.62
August	0.39	0.98
September	0.91	1.19
October	1.62	2.64
November	5.18	5.18
December	5.47	3.03
	30.69	38.41

Selection Work and Individual Tree Recording

Crop recordings have been continued on the fourteen selected trees at the Scott Laboratories. In addition, 100 trees in the Jackson Hybrid block, on the multiple stem system, are being individually recorded. Twenty-five trees in the experiment to observe the "control of variability" by different methods of propagation are also being recorded for crop and growth measurements. In co-operation with the Geneticist at Amani, thirty trees, special Amani selections, are being recorded. During 1938 the selection work has involved the recording of approximately 2,000 samples and the complete preparation of approximately 650.

Shade Experiments

At the Scott Agricultural Laboratories the shade tree arboretum has been extended and to date approximately sixty-five different varieties of shade trees are under observation.

In the variety trial experiment, 15 varieties of coffee are being grown on the single stem and multiple stem systems, half of each pruning system being under shade.

Pruning Experiments

Multiple Stem Pruning.

As part of the multiple stem block has been devoted to vegetative propagation experiments, the Mysore block alone is being recorded for crop weight. The average yield for nine years over the whole plot has been 8.04 cwt. per acre per annum. This year the Mysore block, which is in course of changing over to the new cycle, produced at the rate of 1.93 cwt per acre.

The Establishment of a Multiple of Stems by Different Methods.

The object of this experiment is to determine the most suitable method of establishing the multiple stem system under Scott Laboratory conditions. Crop weights for the two years during which the experiment has been conducted are given, together with details of the systems.

	LB. OF CHERRY	
	1937 <i>Lb.</i>	1938 <i>Lb.</i>
Plot 1 : Guatemala system	243	192
Plot 2 : Guatemala system, but select verticals along stem	225	130
Plot 3 : Single stem for two seasons, then convert	146	229
Plot 4 : Costa Rica system, capping system . .	117	54
Plot 5 : Costa Rica system, new system	84	171
Plot 6 : Capping system, ordinary	292	160
Plot 7 : Capping system, plus removal of best head	319	191

A Comparison of the Multiple Stem System of Pruning versus the Single Stem System.

This experiment, statistically laid out in randomized blocks, replicated twelve times, is designed to test out the multiple stem system as against the single stem system. Each block consists of twenty trees completely surrounded by a border row. The coffee, planted in 1937, is of the Bourbon variety. The seedlings in the multiple stem blocks were bent over on the "Agobiada" system in December, 1937. To date no crop has been recorded and any blossom during 1938 was stripped to give the trees every chance of becoming well formed.

Multiple Stem versus Different Methods of Single Stem Pruning.

This experiment has been laid down to determine whether, by modifying the recognized system of single stem pruning, costs of pruning might be brought to a level com-

parable with those of the multiple stem system. Four methods are being tested in randomized blocks, replicated six times. The whole pruning experiment is superimposed on a manurial experiment made up of three treatments; full mulch, alternate row mulch and box ridging.

Modified Pruning.—System I is an attempt to develop an open strongly framed tree. A limited number of primaries are cut at approximately 10 inches from the main stem. The secondaries produced from the end of the primaries are in turn cut at approximately 10 inches so that a fan shape is gradually developed from each primary.

Modified Pruning.—System II is similar to ordinary single stem but has a reduced number of primaries.

System III is ordinary single stem pruning.

System IV is ordinary multiple stem pruning.

The experiment was planted in April, 1936, with a green tip Bourbon type coffee. Up to the end of 1938 all light blossoms had been completely stripped, but in December all systems bore a heavy blossom so that crop recording will begin during the coming season.

Spacing Experiment

This experiment consists of five blocks of coffee planted in 1932 at different planting distances. Each block is in turn capped at three different heights. Crop from plots of six trees within each of the fifteen experimental blocks has been recorded since 1937. Details of the experiment are given below.

SPACING			LB. OF CHERRY	
			1937 Lb.	1938 Lb.
9'×9' Square	537 t. p. a.	Capped 5'	45	76
9'×9' "		" 4' 6"	59	44
9'×9' "		" 4'	44	37
8'×8' "	680 t. p. a.	" 5'	51	90
8'×8' "		" 4' 6"	42	68
8'×8' "		" 4'	42	76
7'×7' "	889 t. p. a.	" 5'	24	166
7'×7' "		" 4' 6"	28	70
7'×7' "		" 4'	9	77
8'×8' Triangle	785 t. p. a.	" 5'	55	99
8'×8' "		" 4' 6"	34	79
8'×8' "		" 4'	38	85
7'×7' "	1,025 t. p. a.	" 5'	17	127
7'×7' "		" 4' 6"	14	77
7'×7' "		" 4'	21	53

Planting Experiment

This experiment, planted with Bourbon coffee seedlings in October, 1937, is designed to test the effect of planting coffee seedlings in holes of different sizes. The experiment consists of five treatments replicated forty-six times as single tree plots. Effect on vigour and crop recorded from individual trees will be noted in due course. The details of the treatments and the layout are given in the 1937 report.

Sizes of holes are as follows: $3' \times 3'$; $2' \times 2'$; $1\frac{1}{2}' \times 1\frac{1}{2}'$; $\frac{1}{2}' \times \frac{1}{2}'$.

Replanting Young Seedlings in Old Established Coffee.

This experiment is being conducted in a block of Blue Mountain coffee planted in 1925. The object is to determine the most economic method of replanting in an existing plantation. The treatments consist of:—

- (1) Digging out the old coffee before replanting.
- (2) Interplanting seedlings between the rows of old coffee, and allowing the latter to remain for one or two years.

Notes will be made on the effect, if any, on the inter-planted seedlings and crop is being recorded from the blocks of old coffee so that a balance may be struck between the complete loss of crop where the old coffee has been cut out and the gradually diminishing crop due to cutting out the old trees as the new seedlings are developing. The seedlings of Bourbon type coffee were planted out in October, 1937. For the details of lay-out and treatments, see the 1937 report.

Liquoring Experiment

In view of the controversy among coffee planters regarding the quality of coffee obtained from trees of different age, this experiment has been laid down to determine whether there is any difference in the quality of the bean produced from:—

- (1) Old established single stem trees.
- (2) Sucker growth from stumped trees.
- (3) Young seedlings.

The experiment was begun in 1937 in a plot of old established Mocha coffee. Each treatment is duplicated. During 1938 the old coffee was heavily pruned so that the bearing wood on all three treatments would be of comparable age. The first crop will be harvested during the coming season. The liquoring test will include a note on the physical characteristics of the beans from each treatment.

Spraying Experiments

Carbide Bordeaux Spraying with Headland Pumps.

This experiment, begun in 1934, has been continued and the results in 1938 have fully justified expectations. Overcropping in 1936 resulted in only small crops throughout in 1937, but so rapid has been the recovery in the second year in the sprayed blocks that excellent crops have been produced during 1938, while the control (unsprayed) block is still suffering from the effects of the 1936 overcropping. Full details of cropping since 1934 are given below. As the drought of 1938 made itself felt, so striking were the results in the retention of green leaf on the sprayed blocks that a platform was erected from which the whole experiment could be overlooked. Approximately five weeks before the slightest sign of yellowing appeared in the sprayed blocks, the control block was completely sere with heavy leaf fall.

	CROP WEIGHTS IN CWTs. OF CLEAN COFFEE PER ACRE					Average Five Years
	1934-5	1935-6	1936-7	1937-8	1938-9	
1 per cent Carbide Bordeaux :						
March	5.78	6.30	20.90	4.10	13.75	10.17
March-June ..	5.70	5.99	23.40	4.00	19.84	11.79
$\frac{1}{2}$ per cent Carbide Bordeaux :						
March	6.50	6.13	14.20	2.00	9.92	7.75
March-June ..	6.40	10.61	16.60	6.30	14.93	10.97
Control	3.60	2.05	10.00	0.78	5.50	4.39
$\frac{1}{2}$ per cent Burgundy Mixture : March ..	8.40	4.70	21.00	2.10	17.50	10.74
AVERAGE PLOT YIELDS	6.06	5.96	17.68	3.21	13.57	9.30

Fog Spraying.

As regards fog spraying, 4 per cent Bordeaux mixture applied at the rate of $\frac{2}{5}$ pint per tree is recommended, applied in March and June. In the spraying experiments two new blocks have been incorporated. Treatments are as follows:—

4 per cent Bordeaux applied by fog spraying in March.

4 per cent Bordeaux applied by fog spraying in March and June.

Crops from these blocks will be recorded and should furnish a useful comparison contrasted with the crops from the headland pump blocks.

Refilling Gaps in Established Coffee

The result of this experiment was foreshadowed in the last report and is not in any way unexpected. Two years from planting, the position is that 75 per cent of the seedlings comprising bare-planting, ball of earth, and basket planting, have made excellent progress with a number bearing a light crop, whereas only 12 per cent of the old trees, comprising stumped, parrot-perched and cut-up, have made equally good growth. The stumped old trees have done best with 50 per cent making good progress. With the seedling material, the ball of earth appears to be the most satisfactory method of planting, since nearly 90 per cent of the trees are doing well, while planting in 2 feet cube holes shows 85 per cent of trees doing well as compared with 60 per cent in small holes 6" $\times$ 1'. The use of manure at planting has certainly improved the growth and induced early cropping.

Germination Experiment

This experiment, using Harar coffee, was planted out in 1938 and is an attempt to ascertain whether the speed of germination of the seed may be correlated in any way with the ultimate habit and cropping of the mature tree. Seventy-five individual trees are being observed. The speed of germination of each of the 75 seeds was noted while in the nurseries.

Variety Trials

The main variety trials are still continuing, the following coffee types being under observation both as single and as multiple stem trees:—

Kenya Selected A.	Harar.
Kenya Selected B.	Amfillo Bronze Tip.
Columnaris.	Amfillo Green Tip.
Bourbon.	Geisha Bronze Tip.
Padang.	Geisha Green Tip.
Blue Mountain.	Kent's F5.
Mysore.	Mocha.
Guatemala.	

A new experiment, consisting of a further stage in variety trials, has been planted out during 1938. The object of this experiment is to test out the four main types of coffee which, from past observations, are at present considered to be most suited to conditions at, or equivalent to those of, the Scott Agricultural Laboratories. As the experiment has been laid down according to statistical requirements in the form of two

regular latin squares, it is hoped to obtain definite results as to which of the four varieties is the most suitable for our conditions. Observations will be made on crop, habit of growth, bean characteristics and liquor. All blocks in one latin square will be grown on the multiple stem system, while the other will remain on the single stem system. Each treatment consists of eighteen trees replicated four times in each of the two latin squares. For details of lay-out see plan below:—

SINGLE STEM	MULTIPLE STEM
D B A C	A B D C
A D C B	B C A D
B C D A	C D B A
C A B D	D A C B

A—French Mission

B—Kenya Selected A Type

C—Kenya Selected B Type

D—Harar

Border Row—Columnaris

Soil Erosion

Throughout the year anti-soil erosion work has continued. Wherever necessary old ridges have been re-made and planted up, principally with *Lathyrus* sp. (Everlasting pea). All ditches and road edges have, however, been planted up with *Erigeron mucronatus* (Mexican Daisy).

All new land prepared but not yet planted up with coffee has been put under *Tephrosia vogellii* to act both as a soil stopwash and also as a mulch.

Coffee Preparation

During 1938 some 2,276 samples were dealt with at the Scott Agricultural Laboratories alone. In addition to the routine samples in connexion with the field experiments at the laboratories numerous fermenting experiments were carried out by Mr. A. M. Pratt in co-operation with Mr. Gethin Jones, who was investigating the effect on liquor of fermenting coffee with foul effluents. In investigating taint in coffee liquor, the following preparation experiments were carried out:—

- (1) Fermentation with water taken from various estates, as the water taken from any estates showed on analysis considerable variation in mineral content.

- (2) Inoculation fermenting coffee from one estate with sludge from—
 - (a) an estate producing tainted coffee;
 - (b) an estate producing an untainted coffee.
- (3) Different proceedings in estate practice were investigated :—
 - (a) Dry fermentation undisturbed.
 - (b) Dry fermentation for 24 hours, washed, then fermented to completion.
 - (c) Under water fermentation undisturbed.
 - (d) Under water fermentation for 24 hours, washed, then fermented to completion.
- (4) Experiments in drying were conducted to test the merits of :—
 - (a) Wire trays.
 - (b) Barbecues.
 - (c) Hessian sheets.

Altogether approximately 1,000 samples were completely processed at the Scott Agricultural Laboratories preparatory to having a final liquoring test.

Microclimatological Study of the Coffee Bush

During 1938 the following recordings were continued on the tree under observation :—

- (a) Weekly measurements of root growth.
- (b) Fortnightly measurement of branch growth.
- (c) Twice daily soil moisture recordings under tree at 1', 2', 3', 4' levels.
- (d) Twice daily soil moisture recordings outside tree at 1', 2', 3', 4' levels.
- (e) Twice daily measurements of evaporation inside tree.
- (f) Twice daily measurements of evaporation outside tree.
- (g) Twice daily measurements of wind inside tree.
- (h) Twice daily measurements of wind outside tree.
- (i) Twice daily soil temperatures under tree at 1', 2', 3', 4' levels.
- (j) Twice daily soil temperatures clear of tree at 1', 2', 3', 4' levels.

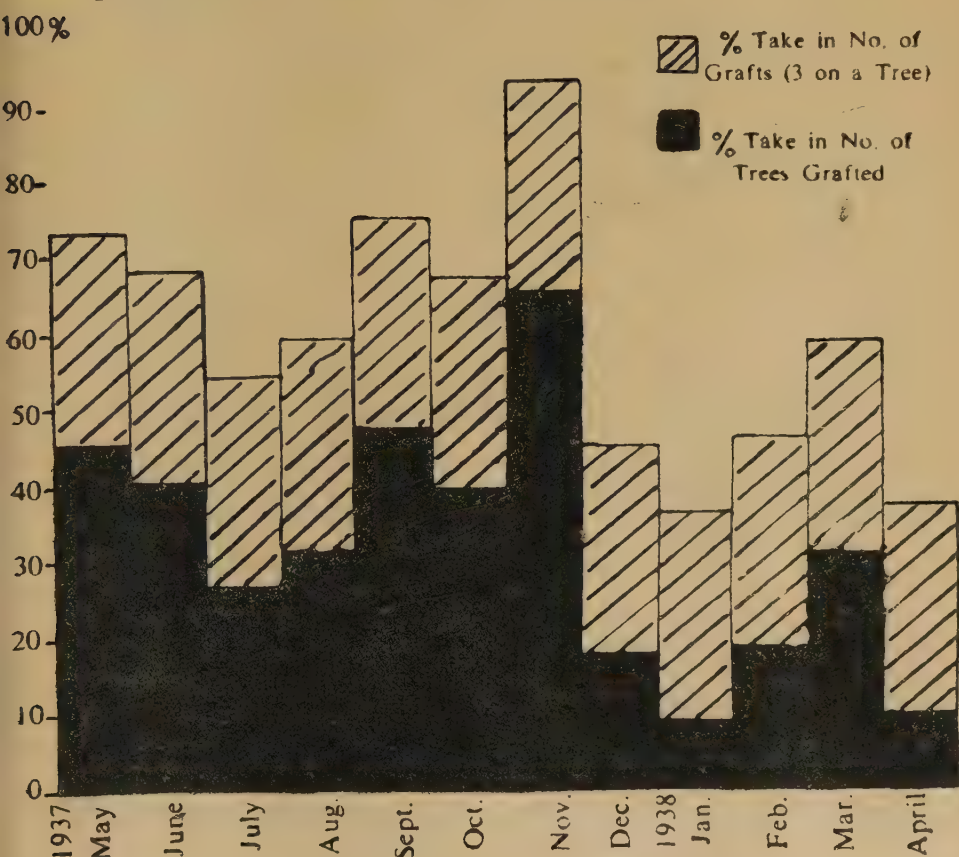
S. GILLETT,
Agricultural Officer and Experimentalist.

VEGETATIVE PROPAGATION WORK

Grafting

The co-operative experiment, partly on the technique, but especially on the best period for, top-working coffee plantations, which was started in 1937, was concluded in October, 1938.

The experiment was successful in proving that the top-working of coffee can be successfully undertaken, and that it is only a matter of time before it becomes a commercial practice.



The histogram shows the percentage taken, in number of grafts, and in number of trees grafted, from month to month during the period of the experiment. It was found that an economic number of "takes" could only be infected if warm, moist weather conditions prevailed, at and for a few weeks after the time of grafting. If the operation is carried out during hot, dry conditions, or cold, wet conditions, failure will result.

A further experiment on top-working, covering various points which it was not possible to include in the previous experiment, was started in December.

Selected individual trees are being tested in the field by random top-working in a plot of twelve-year old trees.

A number of native employees on coffee estates were trained in the technique of grafting during the year.

Cuttings

A block of electrically heated propagators was built and was ready for use in August. It is hoped that this extra accommodation will speed up the multiplication of clonal material.

Early in the year a new technique was evolved for the treatment of cuttings with growth substances. Briefly, the procedure is to stand the cuttings in a solution of the growth substance, contained in a vacuum desiccator. The air is exhausted from the desiccator and consequently from the cuttings. The vacuum is then broken, and the returning pressure of air forces the solution into the basal parts of the cuttings. The whole process occupies ten minutes, instead of the 12–18 hours with the ordinary method. It is a particularly useful method in the case of leafless cuttings, which often fail to absorb the solution when treated in the ordinary way. The process was made public in a letter to *Nature*, and is now a routine practice at the Scott Agricultural Laboratories.

The use of growth substances, though of great assistance in the rooting of coffee cuttings, is by no means the only factor involved. The problem is a complex one, and is receiving the closest attention.

T. H. JACKSON,
Laboratory Assistant.

Karimani Field Station, Thika

Pruning

The experiment, multiple stem versus single stem, with and without regulated primaries, mentioned in last year's report, was begun in January, 1938. The lay-out takes the form of four randomized blocks with an individual plot size of 52 trees. The treatments are as follows:—

- (i) Single stem pruning with all the existing primaries left on the trees.
- (ii) Single stem pruning on a reduced number of primaries.
- (iii) Multiple stem. This system is being established by converting the single stem trees.

The yields from the various treatments will be recorded as soon as all three pruning systems are properly established.

Shade Experiments

The arboretum, which has for its object the study of the adaptability to the conditions of possible new shade trees, has been considerably extended and now comprises twenty-four species.

In addition, there is a co-operative experiment on Kari-maní Estate in which selected species are being tried out in plots of 16 or 20 trees each. The following varieties are represented in this experiment:—

Commiphora sp.
Maesopsis eminii.
Enterolobium timbouva.
Entada abyssinica.
Machaerium tipu.
Millettia dura.
Cordia holstii.
Ficus guapalocarpa.
Ficus sycomorus.
Ficus sp.
Erythrina caffra.
Acrocarpus fyaxinifolius.

Spraying Experiments

An experiment to determine the relative effects on leaf fall of Bordeaux fog spray and sulphate of ammonia was begun in March. Plots of 30 trees were used, and the treatment was repeated, making two plots of each. Further replication was not possible, owing to lack of suitable coffee. The treatments were as follows:—

- (i) 4 per cent Bordeaux fog sprayed twice annually.
- (ii) 4 per cent Bordeaux fog sprayed once annually.
- (iii) Sulphate of ammonia—2 applications of 75 lb. per acre each.
- (iv) Control—no treatment.

All the plots carried this crop well and there were no obvious differences between the treatments.

New Copper Sprays versus Bordeaux Mixture

The following copper sprays were compared with 4 per cent Bordeaux fog spray. Two strengths, based on the copper content, were tried, viz. 3 per cent and $1\frac{1}{2}$ per cent, on 20 tree plots. The sprays were:—

- (a) Cosmic copper.
- (b) Cosmic copper plus Actin.
- (c) Emulsified cosmic copper.
- (d) Vermorite.

The appearance of the trees two months after spraying revealed the fact that the 4 per cent Bordeaux fog spray was as effective as the proprietary articles, and very much cheaper.

Manurial Experiments

An experiment to test the effect of applying bone meal with and without *boma* manure was begun in May. The treatments are :—

- (i) *Boma* manure at 2 *debies* per tree.
- (ii) *Boma* manure at 2 *debies* per tree plus bone meal at 200 lb per acre.
- (iii) Bone meal alone at 400 lb. per acre.
- (iv) Control—no treatment.

The treatments were applied to plots of 30 trees replicated four times in randomized blocks. Crop yields will be recorded over a period of years and should give very valuable information as to the value of bone meal for coffee in this area.

The Effect of Soil Treatment on the Mealy-bug Ant, Pheidole punctulata

A long range experiment was started at the request of the Entomologist in charge of mealy-bug control, which is designed to try out a number of soil treatments popularly credited with having some influence on the habits of the mealy-bug ant. Plots of a third of an acre each are treated as follows :—

- (a) Continuous bare soil.
- (b) Continuous mulch—Napier grass applied annually, the old mulch being dug in.
- (c) Mulch after the short rains, i.e. December till March.
- (d) Mulch after the long rains, i.e. July till October.
- (e) *Boma* manure at 12–14 tons per acre.
- (f) Green manure planted and dug in annually.
- (g) Permanent cover crop—Everlasting Pea (*Lathyrus* sp.).
- (h) Box-ridging.
- (i) Average *shamba* practice—digging in weed growth.

A survey of the ant population will be carried out in due course by the Entomologist.

Banding Grease Trials

These are reviewed by the Entomologist.

Individual Tree Recording

There are now 693 individual trees under observation for yield and quality. This work requires careful supervision at picking time and, though no immediate results are forthcoming, it is hoped that it will lead to the selection of high yielding strains, especially suited for local conditions.

Grafting Trials

In January a number of trees of French Mission type had the primaries cut up to induce the production of suckers on which was grafted scion material of the following varieties:—

- (a) *Columnaris*.
- (b) Jackson's Hybrid.
- (c) Harar.
- (d) K.s.B.
- (e) K.s.A.
- (f) Mocha Clone.

Control grafting, using French Mission scion material, was made for comparison.

At the end of the year an experiment was begun, similar to one previously carried out at the Scott Laboratories, to find out the effect of the time of the year on the percentage of successful grafts. The result of this experiment will provide a useful check on the results obtained at the Scott Laboratories.

Variety and Type Trials

At the beginning of April a number of varieties and selections was planted on the standard plan, part shaded, part unshaded, part on single stem and part on multiple stem.

Varieties:—

- Geisha.
- Amfillo.
- Columnaris.
- Bourbon.
- Kenya Selected.

Selections:—

- S.L. 2 A deep bronze tip, not unlike Harar, commonly found in French Mission coffee. It originated at Whispers Farm.
- S.L. 3 Light bronze tip; selected tree at the Scott Laboratories from seed from one estate, Solai.

- S.L. 4 Green tip Bourbon type. Parent tree at Anmer Estate, Kiambu.
- S.L. 6 A vigorous type tree in Kent's at the Scott Laboratories.
- S.L. 8 Green tip Bourbon type; originated at the Scott Laboratories. Conspicuous for its narrow inter-nodal spacing and small leaf.
- S.L. 10 A robust selection from Harar at the Scott Laboratories.
- S.L. 14 Bronze tip from a drought-resistant tree at the Scott Laboratories. It produces a good round bean.
- S.L. 17 Similar to S.L. 14. A re-selection.
- S.L. 28 Selected at the Scott Laboratories from "Drought Resistant T.T.", originally introduced from Tanganyika by a Mr. Arthur Trench. It produces a good round bean.
- K.7 A selection from Kepchomo Estate, Nandi.

MAKUYU SUB-STATION

In January a start was made on the land made available through the kindness of Kakugi Fibre Lands, Ltd., who also carried out the initial ploughing and preparation most efficiently.

A spacing trial, using French Mission type plants, was planted, which includes the following treatments:—

- (i) Seven by seven feet triangular.
- (ii) Eight by eight feet square.
- (iii) Ten by ten feet triangular.

A variety and type trial similar to that at the Karimani Experiment Station has also been planted. All the varieties and types used at Karimani (q.v.) were planted in this plot, with the exception of S.L. 6, of which there was not enough material.

J. T. T. SCHOUTEN,
Field Assistant.

Kepchomo Experiment Station: Nandi and District

Cultural and Manurial Experiments

Conversion from Single to Multiple Stem.

This experiment, which is being carried out at several centres, was referred to in the 1937 report. The treatments and the results of the comparison to date are as follows:—

(a) *Complete stumping.*—There is so far no doubt that, in order to ensure a maximum amount of sucker growth, this method is by far the best. In addition to this, a more even stand can be expected. The stumping was begun in April, 1937, and sections were stumped each month. It is too early to comment on the merits of any particular month, but the stumping in April or May of 1937 gives promise of a good preliminary crop in 1939. The average height of these suckers is 4 feet 6 inches.

(b) *Cutting up and leaving a canopy.*—It is obvious that in an area such as Nandi, where an overhead tree shade has of necessity to be maintained, unless great care is exercised there is a danger of producing a very spindly sucker growth by this treatment.

(c) *Capping at 3 feet.*—The trees could with advantage have been capped at 3 feet 6 inches, thus giving a greater bearing surface without hampering the subsequent picking of the suckers from the crown. These suckers give promise of a good flowering in March, 1939.

(d) *Cutting up one side.*—The same remarks apply here as in the case of (b) above. Sucker growth is very uneven. It is of interest to note that at Savani Estate, where the overhead shade is lighter and the temperature conditions warmer than at Kepchomo, the suckers make very satisfactory growth on this system.

Re-establishing Plantations.

Interplanting versus removing the old coffee before planting. This experiment was begun at Kepchomo in June. Growth has been slow throughout. It was observed that during the recent dry spell the interplanted trees suffered less than those growing on the cleared coffee land.

The Effect of Phosphates with and without humus.

An experiment was laid down during the year on a five-sided latin square with the following treatments:—

- (a) Boma manure at 10 tons per acre.
- (b) Clean weeding.
- (c) Green manure.
- (d) Green manure plus phosphates at 250 lb. per acre.
- (e) Weeds plus phosphates at 250 lb. per acre.

The coffee used in this experiment is spaced at 7 × 7 feet and, as a result, the green manure (field peas), made but little growth.

The Effect of Potash Fertilizer.

This experiment was continued.

The Effect of Root Pruning.

Deep trenches were dug in a patch of coffee with the object of forcing flower bud growth, but no result was obtained on account of the wood being immature.

An Experiment on the value of Tropical Mortegg for encouraging the production of suckers.

The possibilities of this substance for inducing sucker growth were tested by treating coffee trees as follows:—

- (i) Tropical Mortegg painted on the stems.
- (ii) Stems cleaned and moss and lichen removed.
- (iii) Stems untouched as a control for comparison.

No beneficial effects were observed. It was noted, however, that sucker growth was induced by the removal of an upright from trees having more than one stem.

*Spraying Experiments**New Sprays.*

The following colloidal copper sprays were tested: Copper Cosmal; Cosmic Copper.

The former was used at a strength of one in two hundred and the latter at three pints of the preparation in one hundred gallons of water. Control spraying with one per cent carbide Bordeaux was carried out for comparison. The times of application were (a) before flowering and two weeks after flowering, (b) after flowering and then two or three weeks later. Diseased berry counts were made and the percentage is to be worked out when the 1938–39 crop is picked.

Time of Application of Spray Experiment.

This is designed to compare the Savani method, i.e., spraying after flowering and then 2–3 weeks later, with the

more common procedure of spraying before flowering and then again after flowering. Each treatment is applied to a block of two thousand trees, while a third plot is left unsprayed for comparison.

Monthly Spraying Observations.

Four trees were sprayed each month for observational purposes, especially on the incidence of coffee berry disease. No differential effects were observed. The work was hampered to some extent, however, by lack of crop.

Kamarai Estate.

Applications of 100 and 200 lb. of sulphate of ammonia were tested for tonic effect on the trees against 1 per cent Bordeaux mixture. This plot was subsequently pruned heavily and as a result no observations were possible.

At Chepeli and Kwoisos Estates in Songhor experiments on the effect of 4 per cent Bordeaux mixture as a fog spray on leaf fall gave negative results.

Spray versus Shade.

An experiment was laid down as follows:—

- (a) Shade alone.
- (b) Shade plus spray.
- (c) Spray alone.
- (d) No shade and no spray.

Observations on these plots will be continued in 1939.

Variety and Type Trials

At Kepchomo new land was prepared and a start made with variety trials. Amfillo, Geisha and three climatological selections, H3B, J2D and No. 62, were planted.

Tree Selection and Recording

The search for trees resistant to coffee berry disease continues. In all 56 trees have been found in four estates that appear to have some measure of resistance and these are being recorded individually. Material from one of these has been grafted on old root stocks.

At Sotik the individual tree and block recording has been continued.

Four selections resistant to leaf disease have been made by Mr. Walker of Legetet Estate, Muhoroni, and these are being individually recorded. Material from the two original selections has been grafted on old root stocks.

Shade Tree Trials

The following is a list of shade trees planted during the year at Savani; 20 trees of each species were planted at a

spacing of 36 × 36 feet. A note is added on the difficulty or otherwise of establishing the seedling trees.

- (1) *Entada abyssinica*—very bad.
- (2) *Albizzia gummifera*—bad.
- (3) *Machaerium tipu*—fair to good.
- (4) *Albizzia coriaria*—good.
- (5) *Ficus sycomorus*—fair to good.
- (6) *Enterolobium timbouva*—fair.
- (7) *Millettia dura*—bad.
- (8) *Markhamia hildebrandtii*—fair to good.
- (9) *Trema guineensis*—fair.
- (10) *Erythrina caffra*—good.
- (11) *Neoboutonia macrocalyx*—good.
- (12) *Cedrella toona*—good.
- (13) *Maesopsis eminii*—very fair.
- (14) *Ficus guaphalocarpa*—fair.
- (15) *Ehretia sylvatica*—good.

It would appear that the latter half of the year is the better period in which to plant.

Vegetative Propagation

In the propagators, three types of media were tested, forest loam, loam and sand, and sand alone. At the same time, various types of cuttings were tried. It was found that a mixture of loam and sand did best with 28 per cent of rooted cuttings. Loam alone was next, with 20 per cent. The test was carried out in a sunken artificially heated propagator.

In a second propagator, sunken but not heated, poor drainage caused complete failure of the cuttings to root.

Grafting and Inarching

These operations form part of the preliminary work necessary to perfect the technique for the conversion of existing plantations to a type resistant to coffee berry disease. Grafting was carried out on a block of mature French Mission coffee, the scion material being from imported Blue Mountain seedlings. The climatic conditions in Nandi make grafting a comparatively simple matter and from observations made June and July are probably the best months. A monthly grafting experiment is being continued which includes a test on the effectiveness of wax. The indications are that wax is unnecessary.

Inarching has been put to test in a block of mature French Mission coffee at Kepchomo, using imported Blue Mountain seedlings. It is too early as yet to judge the success or otherwise of the practice.

E. C. M. GREEN,
Assistant Agricultural Officer.

Kitale Experiment Station

The climatic conditions during the year were fairly normal for the district. The rains started somewhat later than usual, however, and consequently flowering and picking were later. The rain-fall was 43.60 inches, compared with an average of 51.53 inches for the past five years.

Shade Tree Trials

The shade versus no shade experiment, the preliminary results of which were given in the 1937 report, is now an extremely good demonstration of the necessity for shade in coffee in this district. During the first two years of cropping the unshaded coffee has carried very heavy crops and is now dying back badly, whereas the shaded coffee which has borne moderate crops is in good condition and looks like bearing well for some years to come.

Of the fifteen species of shade trees planted out in 1934 to 1935, the majority appear to be unsuitable for one reason or another. The most successful species are *Machaerium tipu*, *Dalbergia assanica*, *Acrocarpus fraxinifolius*, *Ficus sycomorus* and *Grevillia robusta*.

Variety and Type Trials

Seedlings of all the available varieties have been planted out, together with a number of types specially selected for high yield and resistance to Elgon Die-back and coffee berry disease.

Spraying Experiments

Experiments with Bordeaux spraying at $\frac{1}{2}$, 1 and 4 per cent strengths were begun on two estates with a view to comparing the relative effects of the treatments over a number of years. Unsprayed plots are included for comparison. It is unlikely that there will be any very significant difference in the yields of the sprayed and control plots in the first year, but there is a marked improvement in the general appearance of the sprayed plots, especially under shade, as compared with the unsprayed plots.

Cultural Experiments

Mulching.

An experiment to test out different ways of mulching was begun this year. The treatments are as follows:—

- (i) Mulching between the rows of coffee.
- (ii) Mulching under the trees.
- (iii) Planting Napier grass in alternate rows and using the leaf for mulching.
- (iv) Control—no mulch.

Size of Holes Trial.

An area of coffee was planted in 1938 to observe the effect of various sizes of holes. Holes of the following cubic capacity are under trial: 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$ and 3 cubic feet. The holes were prepared three months before planting and filled with top soil.

Spacing Trial.

An experiment was begun this year on the problem of the most suitable spacing to adopt. The spacing distances being tried are:—

7×7 feet—single stem system.

9×5 feet—single stem system.

9×9 feet—single stem system.

9×9 feet—multiple stem system.

Vegetative Propagation Work

In the Cherangani District, where coffee berry disease is a major problem, an area of coffee of the susceptible French Mission type, has been taken over for converting to the Blue Mountain variety by inarching. The required Blue Mountain seedlings were planted out during the early part of the rainy season in 1938, and inarching was started at the end of the year.

Also, an acre of old coffee alongside was inter-planted with Blue Mountain seedlings to enable a comparison to be made between the two methods of converting susceptible coffee to a resistant type.

Fermentation and Factory Preparation

During the past few seasons the flavour peculiar to Trans Nzoia coffee has caused concern amongst the local planters, on account of the fact that coffee so flavoured realized £10 to £15 per ton less than normal Kenya coffee. At the instigation of the Trans Nzoia Coffee Planters Association, a series of experiments was undertaken with the 1938-39 crop, with a view to investigating the possibility of fermentation or factory preparation being responsible for the flavour. This work is still in hand.

E. COTTINGTON,
Assistant Agricultural Officer.

Annual Report of the Soil Chemist

The Soil Chemist was absent on leave from 17-2-38 to 15-10-38, leaving four months only on duty during the year. During this period 116 samples were dealt with in the laboratory. The major portion of these, amounting to 61 samples of coffee, were concerned with an investigation into the possible effect of specific coffee micro-flora on coffee liquor. Fifteen samples of coffee factory effluents were analysed to complete the investigation on the reduction of the pollution of streams by coffee factory effluents. Twenty-six samples of soil and six samples of manures were examined and reported upon for individual coffee planters. A further eleven samples of soil were reported upon for other farmers. Eight samples of factory water and coffee were analysed in connexion with the effect of iron on taints in coffee.

Investigational Work

During the period under review three investigations begun in the previous year were brought to completion. The laboratory investigation on the potash status of the Kikuyu red loam, the major coffee soil of the Colony, has shown that there is a very good reserve of potash in these soils and that much of this is very readily available. Even very red, worn-out soils contain good reserves of available potash. Analyses have shown that average applications of bulky organic manures are more than sufficient to maintain the supplies. It is advised that planters should study the composition of mixed concentrated fertilizers offered on the market, so as to avoid purchasing those to which potassic fertilizers have been added.

The field and laboratory investigation on the possible effects of specific coffee micro-flora on coffee liquor was completed during the early months of the year. Specific yeast cultures obtained from clean coffee which had been reported upon as "very fine", "unclean", and "foul" respectively, were multiplied and added to freshly picked cherries, pulped beans, and again sugary solutions of these cultures were sprayed on to the ripening cherries on the tree. Sixty samples of coffee taken from six estates were prepared separately and given specific treatments with yeast cultures from known sources. Later, 120 samples were submitted to Mr. Devonshire, the Coffee Board Liquorer, for report. A study of the liquoring reports showed that under the conditions of these trials no treatment had any effect on the resultant liquor of the coffee. Experimental samples of coffee, both treated and control, obtained from certain areas known to have a characteristic liquor or taint, were described as having the particular taint

of the district. Though this work has given negative results in its main purpose of attempting to alter liquor, certain interesting observations can be drawn from the numerous liquoring reports. Very careful *mbuni* preparation, involving the slow drying of the cherry with daily turning, failed to produce a mild coffee; all such samples were characterized as having sourish to sour liquor, typical of *mbuni* coffees. The numerous replications of treatment and further subdividing of these for liquoring purposes served as a means of studying the uniformity of liquoring results. As regards the visible quality factors, such as size and colour of the raw bean and the type and make of the roast, the liquoror's reports were remarkably uniform for coffees from the same source which had been prepared by the same method. When batches of similar coffee cherry were prepared by the dry *mbuni* method, the visible factors were again uniform, but differ from the values allotted for the wet preparation of the same coffees. The size and colour of the raw bean and the "make" of the roast are inferior, whereas the "type" of roast is somewhat higher in the case of *mbuni*-prepared coffee. Another feature of the liquoror's report showed that, although sub-samples show very close agreement, there were differences in the quality of the coffee obtained from three groups of trees and again with different pickings from the same trees, thus showing variability in supposed similar coffee. This uniformity of the visible factors of coffee quality is, however, often absent in sub-samples when dealing with coffee liquor and more especially if such samples are recorded as having certain adverse liquoring properties such as "fruity", "greenish" or "tainted". The presence or absence of these special liquor characteristics often cuts across a series of sub-samples, and again different cups of the same roast may be given different reports bearing on the presence or absence of "taints". A study of the grouping of these differences suggests that they are mainly due to intrinsic differences in the composition or the summation of all the individual beans present in the sample presented for liquoring. It is suggested that this must be due to the chance presence of relatively very few coffee beans that exert an undue influence on the liquor of the whole. It is believed that the differences are inherent in supposed similar samples rather than due to the personal equation of the liquoror. If it is possible to associate certain kinds of coffee beans and treatment with the various adverse liquoring properties which it is believed that they impart to the whole sample, then the elimination of such beans would greatly improve the liquor of much of the Colony's coffee; also the necessary standardization of coffee

samples for liquoring purposes would be greatly simplified. The essential co-operation of Mr. Devonshire, Liquoror to the Coffee Board, in this work is gratefully acknowledged.

Field and laboratory work on the reduction of the pollution of streams by coffee factory effluents, carried out in conjunction with Mr. H. E. Carrick, Hydraulic Engineer of the Public Works Department, has been completed and a full report has been issued. The amount of pollution in terms of effluent dry matter carried by different flows of factory water was determined for four representative coffee factories. It was found that the most highly polluted flows were the main tank effluent during pulping and the first washing water, both carrying about 1 per cent of waste dry matter. The pulp-carrying water and the second washing water both contained about half as much waste matter. Bearing in mind the need to remove as much waste matter with the minimum loss of stream water, it was found that the diversion of the main tank washing and the two washing waters would remove more than a third of the waste matters with the loss of about an eighth of the total water used at the factory. It is recommended that these more polluted flows be diverted into a series of suitable seepage pits, so that the solids can be deposited and that the matter in solution be absorbed by the natural earth filter beds. About half the total waste matter is carried in the pulp-carrying water, but the volume of the latter is too large to be diverted into pits; this would cause too great a loss of stream water, which is often very low during the picking season. It was found that pollution could be reduced by the use of an efficient pulp separator placed as near to the pulper as possible, and by proper control of the pulp heap. The Coffee Pollution Committee has adopted the report and has made a series of observations and recommendations. The most important of these deal with the proper siting and control of the pulp heap and the use of efficient pulp separators placed as near as possible to the pulper. It is recommended that effluents from the main tank and the two washing waters be diverted in a series of adequate seepage pits. A full report of the work appeared in the *Coffee Board Bulletin of Kenya* for January, 1939.

During the latter part of the year simple sand culture work with coffee, using clonal material, was initiated, so as to obtain more information on the characteristic symptoms shown by coffee when certain elements of nutrition are lacking.

Two articles, one on the manuring of coffee, and another on the valuation of manures and fertilizers, appeared in the *Coffee Board Bulletin* during the year.

G. H. GETHIN JONES,
Soil Chemist.

Entomological Work on Coffee

Antestia

The first months of the year were mainly devoted to a continuation of the experimental work on *Antestia*, particularly a study of certain aspects of the pyrethrum dusting method of control. This work was interrupted before completion by the prior and exclusive claims of the mealy-bug work. Preliminary experiments made with various substances mixed with pyrethrum powder for *Antestia* control, including wood ash and tobacco powder, showed that the toxicity of mixtures was less than of the pure pyrethrum powder and indicated that apparent savings through use of a diluent cheaper than pyrethrum powder would be more than offset by a decrease in the efficacy of the dusting. A number of planters, however, appear convinced that they can show savings by diluting the powder with wood ash or tobacco, and, as the use of wood ash mixed with pyrethrum is recommended in the Belgian Congo, further experimentation is desirable.

Mealy Bug

Banding Grease Trials.

Trials throughout the year of various proprietary greases for banding coffee trees showed that a number of greases on the market and a further number of experimental greases were capable in ordinary conditions of preventing ants reaching the trees for periods extending up to several months without renewal. Any general complaints that the banding greases on the market are of low quality or ineffective are not well founded. On the other hand, there is some evidence that different batches of certain brands of grease vary considerably, and some batches do not reach the high standard necessary. Brands of grease in which such faults are allowed to occur in the manufacturing process are likely eventually to be displaced on the market by uniformly good greases, but they cause much dissatisfaction and loss to the planter who uses grease from a sub-standard batch. Periodical practical tests of banding grease enable worthless greases to be detected, and are of value to the planter for this reason, and also to the manufacturer who wishes to experiment in the production of new greases. Such trials, however, even if they are continually repeated, do not completely solve the problem of sub-standard batches. Planters will have to use the grease that trials and their experience prove most consistently to be the

best, and as things are at present no one but the manufacturers of the grease can protect them against the results of using a sub-standard batch of a brand of grease which has previously been tried and found satisfactory.

Biological Control.

Early in May the first shipment of parasites and predators of the coffee mealy bug was received from Mr. Melville in Uganda. From that time the work on mealy bug was such as to exclude all other work.

Twenty-eight shipments comprising fifty-eight separate tins of various parasite and predator material, some reared, others field-collected, were received, and in addition Mr. Melville brought back a number of tins of material on his return to Nairobi at the end of November. The following table gives an analysis of the material received from the fifty-eight tins mentioned:—

	LIVING ADULTS OBTAINED			Whether Reared
	Females	Males	Sex undeter- mined	
Fly	—	—	76	No
Coccinellidæ several species ..	—	—	61	No
Lycænidæ <i>Spalgis</i> sp.	—	—	7	No
Encyrtidæ primary parasites:				
<i>Leptomastix bifasciatus</i> ..	165	273	—	Yes
<i>Anagyrus kivuensis</i>	126	77	—	Yes
<i>Anagyrus</i> sp.	6	3	—	Yes
<i>Anagyrus</i> sp.	19	5	—	Yes
<i>Anagyrus</i> sp.	26	15	—	Yes
<i>Tetraneura</i> sp.	32	149	—	Yes
<i>Pauridia peregrina</i>	—	—	316	Yes
<i>Pseudophycus</i> sp.	—	—	9	Yes
Aphelinidæ primary parasites:				
<i>Cocophagus</i> sp.	33	13	—	Yes
Other parasites (some possibly primary)	—	—	69	No
Secondary parasites received..	—	—	132	*
Total number of mummies received	—	—	2,291	—
Total number of known primary parasites obtained,	—	—	1,267	—

*Some reared to ascertain status.

The above table shows that nine primary parasites were reared in Nairobi. Of these, four were of particular importance, and these were produced before the end of the year in numbers sufficient for liberation. Work at the end of the year was continuing with three others.

The following table gives the weekly production of the four species from September onwards:—

Week Ending	<i>Anagyrus kivuensis</i>	<i>Anagyrus</i> sp.	<i>Leptomastix bifasciatus</i>	<i>Pauridia peregrina</i>	Weekly Total
Sept. 4	160	548	110	60	878
11	201	711	107	39	1,058
18	429	609	253	20	1,311
25	403	491	264	38	1,196
Oct. 2	542	567	239	382	1,730
9	653	1,429	240	788	3,110
16	367	1,569	197	526	2,659
23	407	2,162	354	461	3,384
30	225	2,573	303	467	3,568
Nov. 6	117	2,591	230	239	3,177
13	480	1,859	326	195	2,860
20	*	1,160	110	423	1,724
27	*	488	38	837	1,368
Dec. 3	*	475	44	893	1,417
10	*	1,527	257	1,671	3,455
17	*	3,400	319	1,793	5,512
24	*	3,503	319	1,185	5,007
31	*	2,463	301	1,129	3,893
TOTAL	3,984	28,125	4,011	11,146	47,307

*Large scale breeding temporarily discontinued.

The following liberations were made in 1938:—

Species	District	Number of Liberations	Number of Parasites Liberated
<i>Anagyrus kivuensis</i> ..	Kiambu, Ruiru, Thika, Makuyu, Donyo Sabuk ..	7	3,129
<i>Anagyrus</i> sp. ..	Kiambu, Ruiru, Thika, Fort Hall	4	9,030
<i>Leptomastix bifasciatus</i>	Kiambu, Donyo Sabuk	2	584
<i>Pauridia peregrina</i> ..	Ruiru, Thika, Donyo Sabuk	4	4,454
	TOTAL ..	—	17,197

At the end of the year considerable expansion of the rearing work was occurring, shown later by the fact that by 12th March, 1939, a total of more than 65,000 parasites had been liberated. Some initial recoveries were made during the year of parasites that had bred on mealy bugs in the field, but no species was definitely known to be established.

Prospects of the Work

In order to assess the probable outcome of this work the present position must be apprehended. Before Mr. Melville's journey to Uganda it was known (1) that *Pseudococcus kenyæ* was a recent introduction into the Central Province of Kenya, that it was a serious pest which was extending its range yearly, and that it was attacked by only three species of internal parasites, which together had no appreciable influence on its population level; (2) that *Pseudococcus kenyæ* was present in Uganda and parts of Tanganyika Territory, where it was not a severe pest.

Little or nothing, however, was known as to its status in Uganda and Tanganyika Territory, whether indigenous or introduced, or as to its internal parasites in those countries.

Mr. Melville's researches went to show that the mealy bug is indigenous in Uganda (or, alternatively, must have been there so long that it has all the attributes of an indigenous insect), and also that it supported a considerable number of primary parasites which were undoubtedly a major factor—probably the chief factor—in maintaining it at a comparatively low population level. Further, it is known that the most important Uganda parasites do not occur in the Central Province of Kenya.

The behaviour of the parasites in their new home cannot of course be exactly assessed as a result of observations in the field in Uganda, nor as a result of observations of their breeding in the laboratory in this country, but there seems no reason to doubt that the parasites will become established, and, as essential conditions are similar in certain of the mealy-bug infested areas in Kenya and Uganda, there is good reason to hope for a successful result from the work.

R. H. LE PELLEY,

Entomologist.

MEALY BUG INVESTIGATIONS

General

Throughout the year I was engaged on research on the common coffee mealy bug (*Pseudococcus kenyæ*). In January and February I worked on the banding grease experiments reported on elsewhere by Dr. R. H. Le Pelley; the ant ecology experiment reported on under the Karimani Experimental Station report, and on preparations for my Central African investigations. I left Nairobi on the 2nd March to carry out investigations on *Pseudococcus kenyæ* in Uganda, the Belgian Congo and Tanganyika Territory. The main object of this investigation was to find primary parasites of the mealy bug and to introduce them to Kenya. I returned to Nairobi on the 26th November, 1938, and was then engaged on the parasite-rearing and liberation work until the end of the year.

Travelling by road during the year amounted to 7,366 miles.

*Central African Investigations**Introduction*

An article entitled "Kenya Coffee Mealy-bug Research," published by me in the *East African Agricultural Journal* for May, 1938, gave the position of the mealy-bug research project at that time. Briefly, our knowledge was as follows: The mealy bug had been shown by Dr. Le Pelley to be a new species quite distinct from *Pseudococcus lilacinus*, and this discovery had greatly clarified the problem. The mealy bug was shown to be an insect introduced to the Central Province of Kenya and lacking in internal parasites. The most promising line of research appeared to be biological control, i.e. the introduction of natural enemies of the mealy bug. It was considered that such could be found in the indigenous habitat of the mealy bug. This habitat was not known, but arguments were put forward to show that an area in Central Africa was the most likely one in which the mealy bug would be found to be indigenous. If *Pseudococcus kenyæ* could be shown to be indigenous in that area, then it was almost certain that it would be found to be under the control of specific parasites and that these could be imported into Kenya. The determination of the status of *P. kenyæ* was thus of first importance. The method by which this determination could be made was given. In order to cover the possibility of an insect being both indigenous and introduced in the same continent it was necessary to realize the concept of ecological islands within the continent, these islands being separated from each other by tracts of country in which the insect was presumed to be unable to exist.

Results of Investigations

After leaving Nairobi on the 2nd March, a week was spent in Nyanza Province in order to determine whether *P. kenyæ* was present in that area or not. Neither *P. kenyæ* nor any insect closely resembling it had ever been found in this area, and the work done there merely served to confirm that there was a definite break in the distribution of the mealy bug between Kenya and Uganda.

Proceeding to Kampala, the mealy bug was soon found on coffee, both Arabica and Robusta, on the shade tree, *Gliricidia maculata*, and on several other plants. Detailed examination of many samples of mealy bug showed that the percentage of parasitism by internal parasites was on the average about 60. These early determinations showed that the mealy bug was either indigenous or that it had been present for so long that it could be regarded as indigenous. They were subsequently supported by many further determinations made in the Kampala and other areas, and instances of nearly 100 per cent parasitism were numerous. Control by parasites was thus found to be very marked.

Once this determination had been made the study of individual parasites was commenced. Detailed studies were carried out at two centres, Kampala and Fort Portal. In Kampala the natural enemies of two areas were studied: (a) that represented by Kampala and Entebbe, and (b) that represented by Bukalasa, which lies in an area north of Kampala and in which the dry seasons are more marked. In Fort Portal the natural enemies of the Toro district were studied.

The status of the various parasites occurring in these three areas had to be determined, and the most promising primary parasites bred or collected in sufficient numbers for sending to Nairobi. The parasite complex of the Kampala and Entebbe area proved to be extremely difficult to work out, and comprised at least twenty species of parasites both primary and secondary. In the Bukalasa area and the Toro district the position was much simpler. Thirty consignments of parasites were sent from Kampala and twenty-eight from Fort Portal. Some predators were included in these consignments, but these were extremely scarce in the field in Uganda, apparently because the parasites kept the mealy bug at such a low density that infestations of mealy bug sufficiently large to attract predators were rare.

The insects sent were as under:—

From Kampala.—*Leptomastix bifasciatus*, *Anagyrus kivuensis*, *Coccophagus* sp., Predators.

From Bukalasa.—*Pauridia peregrina*, *Tetracnemus* sp., Predators.

From Fort Portal.—*Leptomastix bifasciatus*, *Anagyrus* sp., *Tetracnemus* sp., *Pseudaphycus* sp., Predators.

A few additional consignments of parasites from Bukoba and Kampala were brought back on my return to Nairobi.

The parasites were received and dealt with in Nairobi by Dr. Le Pelley, and nine different species of primary parasites were reared in the insectaries. Two of these were not purposely consigned because they appeared to be of no practical importance in the field, but were bred in Nairobi from a few insects appearing in consignments of other species. One of these parasites, a species of *Anagyrus*, has shown itself to be the most prolific breeder in the insectaries in Kenya.

Apart from the work of sending parasites to Kenya, an attempt was made to work out the area of indigenous distribution of *P. kenya*. The mealy bug was found to be indigenous in an area partly in Uganda and partly in Tanganyika. This area is an ecological island bounded by distinct natural barriers. In order to delineate this island, investigations had to be carried out in areas outside the island as it is now known. Visits were accordingly paid to the Ankole, Kigezi, West Nile, and Bwamba districts of Uganda, and in the Belgian Congo to the districts of Ituri, Butembo-Beni, Rutchuru, and South Kivu. The mealy bug was found at two points in these areas, namely at Mbarara in Ankole and at Buyaya in Bwamba. There is some evidence to show that the insect is an introduction at these two points; they were isolated records in areas otherwise free from the mealy bug, and the introductions may have taken place from the island of indigenous distribution mentioned above.

The area in which *P. kenya* was found to be indigenous is a very small one, and the explanation of this fact would seem to be that the mealy bug is a fairly recently evolved species which has developed inside a well-defined ecological island.

Investigations at various points within the area of indigenous distribution other than those at which detailed work was done gave an opportunity of studying the different important primary parasites under different conditions, and individual parasites were found to vary considerably in importance in different localities. Thus *Leptomastix bifasciatus*, though not of first importance at lower altitudes, was definitely the most powerful enemy of *P. kenya* in Toro district. Again,

Pauridia peregrina, though dominant at Bukalasa, was found only as a rarity elsewhere. Although it is impossible to say with certainty what the reactions of these parasites will be in a new environment, such observations as the above have given a line as to the possibilities of their use in Kenya.

The same attendant ant which attends the mealy bug in Kenya, namely *Pheidole punctulata*, was found at many points in the course of the tour and in many cases the mealy bug was very vigorously attended. Inside the indigenous area the mealy bug was never found to be more than a minor pest. The largest infestations, amounting to only two or three trees severely attacked in, say, five acres, were always found on Robusta coffee, which seems to be more susceptible to coccids than Arabica coffee. On Arabica coffee in this area the mealy bug had to be searched for very thoroughly and no severe infestation was found. At Mbarara, where the mealy bug is thought to be an introduction, two or three plots of native Arabica coffee were found with fairly severe infestations of this mealy bug.

Acknowledgments

The success of this *safari* was dependent at every stage upon the assistance rendered by the local officers of the Departments of Agriculture of the territories concerned. In Uganda, Mr. Hargreaves, Senior Entomologist, and Dr. Taylor, Entomologist, provided excellent facilities for work in the Kampala Laboratories, much advice on technical points including access to the very valuable reference collections at the Laboratory, and for assistance generally in ways too numerous to mention. The local agricultural officers in the districts visited in Uganda and Tanganyika gave information about their districts and arranged local *safaris* for the collection of material. In the Belgian Congo, I am indebted to M. P. C. Lefevre for his assistance in the Ituri district; to M. Leroy for his assistance at Rutchuru; to M. Stoffels, Director, and to M. Hendricks, Plant Pathologist, of the I.N.E.A.C. Station at Mulungu, for their assistance at South Kivu; to M. P. Lamotte, Belgian Consul General, Nairobi, for considerable assistance in connexion with my visit to the Belgian Congo. I should like to record my appreciation of the services of Maitai Matenge, native laboratory assistant, who accompanied me throughout the tour and who rendered outstanding service, frequently under difficult conditions.

A. R. MELVILLE,

Entomologist.

PART V—BOTANICAL SECTION**A—Annual Report of the Senior Plant Pathologist***Staff*

Mr. C. A. Thorold, Plant Pathologist in the Coffee Team, acted as Senior Plant Pathologist from 1st January to 30th August. I assumed duty as Senior Plant Pathologist on 1st September.

Mr. F. W. Evans, Laboratory Assistant, carried out general laboratory work, including the maintenance of pure cultures of fungi and the general management of the mycological and phanerogamic herbaria during the absence of the Acting Senior Plant Pathologist from the Scott Laboratories. Mr. Evans was also in charge of the wheat stem-rust work at the Scott Laboratories during the year. Additional work carried out included the maintenance of nine strains of coffee fermenting yeasts for the Coffee Section and fortnightly counts of fungi and bacteria in the soil at the Laboratories for the Senior Agricultural Chemist.

Meetings

I attended a meeting of the Pyrethrum Board at Nakuru on 26th November.

The following report is submitted by Mr. C. A. Thorold covering the period he was acting as Senior Plant Pathologist from 1st January to 30th August:—

“Throughout the year I have been stationed at Kapretwa Estate, Mount Elgon. During this period I was Acting Senior Plant Pathologist until 30th August exclusive, when I reverted to my substantive rank of Plant Pathologist. Therefore, for the first eight months of the year, I have had to combine the general duties of Senior Plant Pathologist with those of a more specialized nature as Plant Pathologist in the Coffee Team.

“*Travelling and Safari.*—During the year I travelled 2,382 miles by car and was absent from my station on duty on five nights.

“*Meetings.*—I attended committee meetings of the Trans Nzoia Coffee Planters' Association on 24th June and 2nd September, and general meetings on 22nd March and 28th June.

"Field Days.—These were held and attended as follows:

1st June at Kapretwa Estate, for inspection of my Elgon dieback experiments.

7th October at Department of Agriculture plots, Kitale.

2nd November at Teldet Estates, by kind invitation of Messrs. H. B. Swann and J. F. Perkins, for a discussion of pyrethrum topics, including disease in this crop in particular.

"Extension Work and Tours.—On 1st June I gave an address on local coffee topics at a meeting held at Kapretwa Estate. On 1st December I gave a broadcast talk on Elgon dieback and 'hot and cold' disease investigations from Nairobi Station, in the series of broadcast talks to farmers.

"Estates have been visited in various parts of the Trans Nzoia for the purposes of my investigations and also to give advice on Elgon dieback and coffee berry disease. In January I visited Nandi district to see the progress of the coffee berry disease work at Kepchomo Estate, and to initiate certain new lines of experimental work.

"Visitors.—Visitors from outside the Colony to Kapretwa Estate during the year included Mr. A. Glendon Hill, Director of the East African Agricultural Research Station, Amani, and Mr. L. R. Doughty, Plant Geneticist at Amani. Dr. M. Hille Ris Lambers stayed at Kapretwa for three days when on his way from the Malang Station in E. Java to Europe.

"Work Done: Routine.—I have carried out inspection duties under the Plant Protection Ordinance, but the administration of the Plant Protection Services, including the issue of permits for importing plant material, was attended to by Mr. H. Wilkinson, Entomologist in Charge at the Scott Agricultural Laboratories.

"Whilst I was Acting Senior Plant Pathologist I received a variety of plant disease specimens which were examined in the laboratory, and reports were given on these and other matters on which advice was sought.

"Investigational Work.—As a member of the Coffee Team the greater part of my time available for investigational work has been devoted to coffee problems. Consequently, there was very little opportunity for research on the diseases of other crops which also required investigation. An exception was made in the case of pyrethrum, a brief report on which now follows.

“*Pyrethrum Disease*.—Anxiety about a new ‘disease’ of pyrethrum demanded investigation into its cause and control. I wish to acknowledge the extent to which information on this subject was advanced by the efforts and trials of control methods made by Major F. Chater Jack and Mr. H. B. Swann.

“An affected patch of pyrethrum looks sere and brown. The petals are small and discoloured as contrasted with the clean white ray florets of healthy flowers. The foliage may also be affected; it is shrivelled and silvery at first, rapidly becoming discoloured as it withers prematurely.

“When the flowers on such plants are examined Thrips are invariably found. These insects are frequently concealed within the disc of a flower; only when this is mutilated do the insects emerge. The Thrips feed on the plants, and these activities are particularly serious when concentrated on the peduncle just below the flower head. A roughening of the stalk can frequently be detected. This indicates the extent to which the insects have been feeding there and thereby interrupting the proper flow of foods and water to the flower or bud.

“The foliage of young plants also is attacked. The result is that such plants show the characteristic appearance of mottled shiny areas on the leaves, which is seen also when Thrips attack coffee leaves.

“The experiments carried out on pyrethrum showed that this ‘disease’ was controlled and prevented when plants were kept free from Thrips, thus demonstrating that there was no fungus infection which had to be controlled in addition to the insect infestation. Nevertheless, fungi and bacteria are sometimes present in the plants following the damage by insects. These secondary organisms are not important, except as accentuating the discoloration of the flowers, initiated by the Thrips. The fungi which do occur in the flowers, such as *Alternaria* sp., are not observed to sporulate there. It is possible that they are transmitted by the insects as portions of tissue containing the mycelium.

“There are various parallel cases in the literature of plant pathology. Thrips were believed to be a factor in the spread of *Alternaria* sp. on tobacco leaves in Hungary (R.A.M., X, p. 212). A similar association of Thrips and fungi is considered to be the cause of ‘*moucheture*’ of wheat in Algeria (R.A.M. XIV, p. 91). Whilst it is probable that the disease symptoms may result from direct injury as a response to the wounding

and 'poisoning' by the insect punctures. A disease of this nature has been described on peaches in Italy (R.A.M., XII, p. 229).

"I have made a study of the means for controlling this pyrethrum disease. A successful method would have to be efficient in killing the Thrips. Destruction of these insects is made difficult by their habit of concealment within the flower discs. Fumigation methods would undoubtedly be impracticable on the field scale. It was important to find an insecticide which would be effective in reaching the Thrips in the flowers. Trials were made with proprietary nicotine sulphate in spray strengths of 1:400 and 1:600 with water. The weaker of these was effective, and in later trials a strength of 1:800 has been used with success. Trials were also made with tobacco extract, since a local product is available under the name of 'Tikiller'. This had to be used at strengths of 1:75 at least, but preferably 1:50. There was no opportunity for a proper comparison of the relative toxicities of this extract and the pure nicotine sulphate. On a comparison of effective strengths and cost of materials, the nicotine sulphate appeared to be the cheaper. At a rough approximation it was estimated that a heavy application of spray, sufficient to kill Thrips in the flowers, could not be done for less than Sh. 14 an acre.

"The Entomologist, Mr. H. Wilkinson, had previously recommended spraying with lime sulphur. Trials under conditions on Mount Elgon were not encouraging. The lime sulphur spray was not as effective as the nicotine sprays. It was eventually found that lime sulphur only killed Thrips on pyrethrum efficiently when the plants were first cut down. The spray, applied then to the foliage only, resulted in a sufficient concentration of spray fumes on the insects amongst the foliage. The lime sulphur, applied to plants cut down to near soil level, will kill the Thrips, which it does not do when applied to the crop in the flowering stage. The trials with nicotine sulphate had to be aimed at killing the less accessible insects in the flowers. This has been shown to be a severe test, since the insects are concealed within the flowers where an ordinary application of spray does not reach. Therefore, it may not be economic to spray the crop when flowering, owing to the expense and difficulty of destroying a sufficient number of the Thrips then. It is now recommended to cut down and spray the plants as early as possible, when the season's picking is finished."—C. A. Thorold, *Plant Pathologist*.

Plant Protection Services

Since the departure of Mr. J. McDonald on the 3rd of April, 1937, and subsequent transfer, the administration of the Plant Protection Services has reverted to Mr. H. Wilkinson, Entomologist in Charge at the Scott Laboratories.

*Investigational Work**Wheat*

The work in connexion with stem rust of wheat was carried out at the Scott Laboratories by Mr. F. W. Evans.

Eighteen samples of stem rust from different parts of the Colony were tested to determine the form present. Fourteen of these samples were found to be the form K5 which first appeared in 1937. One sample was found to be a mixture of forms K3 and K5, the former predominating. The remaining three samples were form K2. Forms K1 and K4 were not recorded in Kenya during the year.

The distribution of the three forms was as follows:—

K2—

Molo: January.
Eburru: October.
Lessos: October.

K3 (mixed with K5)—

Njoro: November.

K5—

Naro Moru: February.
Njoro: April, August, September, October (three times), November.
Ulu: June.
Nairobi (S.A.L.): June.
Mau Summit: October.
Molo: November.
Sergoit: November.
Endebess: November.

A sample of stem rust received from Uganda in July proved to be form K2.

Six specimens of rust-infected wheat were collected by the Plant Breeder from various parts of Tanganyika and tested at the Scott Laboratory. Of the three collected in June, K4 was present on two and K3 on the third. Of the remainder collected in August, one was a mixture of forms K3 and K4, another form K4 and the third form K5.

Twelve wheats (including local hybrids and imported varieties) were tested in the seedling stage for their resistance to stem rust.

Cultures of the five physiologic forms known to occur in Kenya were maintained throughout the year.

An artificial stem-rust epidemic (including all five forms) was produced in the Plant Breeder's wheat cage at the Scott Laboratories in April. A similar epidemic was produced at Njoro in June.

Passion Fruit

The "woodiness disease" of passion fruit has now assumed serious proportions in the Trans Nzoia area. Special attention is being devoted to this disease. Done

In September, I accompanied Dr. Storey of Amani on a tour of the affected areas. General recommendations for the control of the disease were drawn up and a scheme of co-operative research between this Department and the Amani Research Station were decided upon.

The disease has now been proved to be caused by a transmissible virus. The occurrence of two or more strains of the virus is suspected.

Other fungi on passion fruit causing diseases of minor importance and not hitherto recorded for Kenya are as follows:—

Alternaria passifloræ Simmonds, causing leaf spots. The fungus was grown in pure culture and shown to be able to infect the fruit.

Septoria fructigena Berk. & Curt., isolated from fruit lesions. This fungus readily caused lesions on leaves and fruit when artificially inoculated. The fungus has previously been recorded from South Africa on fruit of *Passiflora quadrangularis*.

Other fungi, undetermined and associated with root rot and stem canker, were *Phomopsis* sp., *Alternaria* sp., and *Gloeosporium* sp.

Miscellaneous

A "brown patch" disease of golf greens composed of *Cynodon dactylon* was found to be caused by the fungus *Helminthosporium cynodontis* Marignoni.

Sclerotinia minor Jagger was isolated from and was probably the cause of wilting and root-rot of pyrethrum.

Exosporium palmivorum Sacc. was the cause of a severe leaf-splitting of *Phoenix reclinata*.

Grateful acknowledgments are made to the Director of the Imperial Mycological Institute for the determination of various fungi and for the loan of publications.

R. M. NATTRASS,
Senior Plant Pathologist.

B—Annual Report of the Agricultural Officer in Charge of Grassland Improvement

Survey

A considerable amount of time during the year has been devoted to survey work in connexion with special problems which have arisen. In January and February a vegetation survey of the Yatta Plateau was undertaken as a preliminary step in the introduction of a scheme of grazing control aimed at the reclamation of this area, which had been severely damaged in recent years under occupation by the Wakamba tribe. The information obtained from this survey is contained in my report No. GL/RECOND/1/860 of the 28th February, 1938. In connexion with a question of the alienation of land for European settlement, a survey was made in October of the area lying between the Kittermaster Line and the present farm boundaries in Northern Laikipia. This work was carried out in collaboration with the Agricultural Economist, and an account of the vegetation is given in our joint report No. Land 2/272 of the 17th November, 1938.

Vegetation Map

During the year the production of a vegetation map, with particular reference to the grassland types, was undertaken, and this map is submitted as an appendix to the present report.

Visit to South Africa

In addition to the survey work outlined above, a visit to the Union of South Africa and Basutoland was made in company with the Acting Deputy Colonial Secretary and the Soil Engineer of this Department for the purpose of investigating soil conservation methods. A period of approximately one month in March and April was devoted to this investigation, and the results are given in a joint report issued on the 12th of May, 1938.

Progress of Experimental Work

Work has been continued on the lines indicated in previous reports, the main object of the work at Kabete being the production of pasture species suited for use as established pastures in mixed farming areas, both European and native. Investigation has been directed mainly to the groups of eco-types mentioned in the 1937 report, and a considerable number of new types have been placed under preliminary experiment.

Study of Ecotypes

In the *Cynodon* (Star grass) group, the Giant *Cynodon* has continued to give promise, and the trials have been extended to widely different climatic areas of the country. Preliminary reports of success at the Coast Experiment Station have been received, but with the exception of this information little knowledge of the behaviour of this grass in the lower-altitude parts of the country has been gained. As it is believed that the species is particularly suited to the hotter districts, and owing to its strongly stoloniferous habit, it may prove of considerable value in the reconditioning of eroded native areas. A more recently acquired *Cynodon* is one which is found growing near water-holes in arid parts of the country. It appears to be a variety of *Cynodon dactylon*, but it is clearly more drought-resistant than varieties of this species hitherto obtained.

At least six ecotypes of *Chloris gayana* (Rhodes grass) have been obtained locally, and recent work has shown that two of these are markedly more persistent than the Queensland type which is at present on the market. As the productiveness of this latter type appears to fall rapidly in the drier areas in about the third year after establishment, the use of one of the more persistent local varieties will doubtless prove of considerable advantage.

Several species of *Brachiaria* have given promise during the year, and outstanding amongst these is *Brachiaria dictyoneura*, obtained from Southern Rhodesia. This species has been recorded from several localities in Kenya and also from other East African territories.

In the experiment mentioned in the 1937 Report, in which a number of grasses selected from previous work have been subjected to a severe treatment of defoliation, those which have been shown best capable of withstanding the treatment, during what has been an exceptionally dry year, are two local types of *Chloris gayana*, *Bothriochloa insculpta*, and *Pennisetum clandestinum* (Kikuyu grass). Those which are distinctly inferior in this respect are now *Cenchrus ciliaris*, the Queensland type of *Chloris gayana*, and two local *Cynodon* species. Despite the fact that the experiment has been in progress for approximately two and a half years, the effect of the severe treatment has only recently become evident.

Kikuyu Grass

Work on the three ecotypes of Kikuyu grass isolated in 1934 (see *Empire Journal of Experimental Agriculture*, Vol. V, pp. 371-377, October, 1937) has been continued. All three

types have proved themselves capable of withstanding a prolonged and severe cutting treatment, but the Molo strain is inferior to the others in this respect. A study of natural seed distribution in this species has been undertaken, and during the year important information has been obtained.

Pasture Legumes

The difficult problem of providing pasture legumes suitable for sowing down in mixture with the grasses has progressed little towards solution. A number of new types, both indigenous and exotic, have been placed under experiment, and recently a considerable collection has been received from Hawaii. An indigenous *Indigofera*, as yet unidentified, appears to offer some promise of success. The Rhodes grass-lucerne mixture is the one which can be most widely recommended for temporary leys.

With the object of producing an adapted type of lucerne suitable for use in pasture, breeding work has been continued. The original material consisted of plants found persisting in pasture on the sites of old lucerne areas at Kabete.

Grazing Experiments

In an experiment designed to test the effects of various intensities of grazing on the natural Kikuyu grass pasture at Kabete, it has been found that the sward has been improved by the heaviest treatments which have kept the ground bare throughout the experiment, and also that the proportion of the indigenous clover, *Trifolium Johnstonii*, has increased in relation to the intensity of the grazing. During the year attention has been directed to the apparent relationship between the presence of the clover and the success of Kikuyu grass. Results have shown that, (a), approximately one year of protection from grazing results in the disappearance of the clover, and that this is rapidly followed by the replacement of the Kikuyu grass by other and less desirable species, and that, (b), a considerable proportion of the clover can be induced to return merely by the control of the rank herbage with shears in the ungrazed controls over a period of one and a half years, and that, further, this return of the clover results in a sward again dominated by Kikuyu grass. This information appears to provide additional evidence of the absolute necessity for the intensive management of natural Kikuyu grass pasture.

Towards the end of the year an experiment to compare established Rhodes grass with the local natural pasture for the purpose of fattening cattle was undertaken in collaboration with the staff of the Veterinary Training Centre at Ngong.

At the beginning of the year a grazing control experiment was put into operation on a 300-square-mile area of the Machakos Yatta Plateau. Effective control of the movement of native stock appears to have been obtained, but as it has so far been found impossible to make the necessary improvement in the permanent water supplies of the northern portion of the area, the plan has had to be modified to await this improvement. There is, however, ample evidence of rapid recovery of the vegetation where protection from grazing has been exercised.

Fodder Crops

Work designed to compare the yields of a number of crops for purposes of storage, to supplement the grazing in times of scarcity, has been continued at Kabete. In this connexion it may be observed that, although *Pennisetum purpureum* (Napier grass) remains the heaviest yielding type, the extremely rapid growth of *Hyparrhenia rufa* results in more frequent crops than in the case of any of the other types under experiment, and an aggregate yield is obtainable in the year which is by no means inconsiderable. This species has the added advantage of easy and rapid establishment from seed. Another type which may prove to be of value under special circumstances is a large *Echinochloa* species, originally obtained from a stream margin in the Songhor district. It has proved successful under dry land conditions, and may be particularly suitable for use under irrigation.

Lectures, Addresses, etc.

Addresses on grassland problems were given to meetings of farmers at Nanyuki in July and Machakos in October.

Herbarium

Considerable additions have been made to the herbarium, and in July of this year a collection consisting of 125 species was sent to the Royal Botanic Gardens, Kew. It is desired again to acknowledge the valuable assistance obtained from this source in the identification of pasture species.

D. C. EDWARDS.

Officer in Charge, Grassland Improvement.

PART VI—ANNUAL REPORT OF THE PLANT BREEDER

Staff Changes

Mr. R. S. Ball, Agricultural Officer, departed on home leave in August, and was relieved by Mr. M. Halcrow. Mr. Thorpe, Plant Breeder, arrived in August on first appointment. The addition of a second plant breeder, apart from ensuring continuity of work, will enable more time to be devoted to plant breeding and selection work on some of the newer crops, such as pyrethrum.

Mr. R. N. Noble, Junior Laboratory Assistant, departed on leave in April and was posted to Kitale on his return.

Correspondence and Meetings

Inward letters, 2,370; outward letters, 2,302.

Meetings of the Wheat Advisory and Pyrethrum Boards were attended, and the field experimental work in the Rift Valley Province was supervised.

Wheat—General

Another very fair season was experienced, good crops being reaped over most of the country, though a few districts suffered badly from rust and drought. An increased acreage was seeded, and an average yield in the region of four bags per acre is anticipated.

In view of the lateness and paucity of the rains in the lower altitude districts, which normally are the earliest to harvest their crops, it was felt that the mills might experience a temporary shortage of wheat in the early part of the season, until the main crop was fit to mill, and 1,450 tons of wheat were therefore imported.

Locusts caused serious damage to individual growers, though the loss sustained by the industry as a whole was small.

New varieties under trial by growers on some scale consisted of wheats Nos. 117.A, 130.B.6.B, a Canadian hybrid, Double Cross x Ceres 721, and Reliance. The variety Sabanero again represented 15 per cent of the crop.

Rust

The new form of stem rust (K5) was present throughout the country and was found to have reached the top altitudes of 9,000 feet. Fortunately, the damage done was not on the whole serious, though some of the lower altitude areas suffered severely, and the new wheat No. 58 was badly affected as before.

The rust studies in co-operation with farmers revealed the presence of form K5 in every case where rust was present, and this form was recorded seventeen times. The field differentials for forms K2 and K4 are unfortunately susceptible to form K5 as well, so it was not possible to determine whether either of these forms was also present. However, rust samples collected in the field and sent down to the pathological section of the Scott Agricultural Laboratories revealed the presence of form K2 on two samples, so it is likely that form K2 was also present to some extent over the country. Form K3 was recorded once late in the season. It would appear that form K4, which was epidemic several years back, was in abeyance during the year.

Artificial rust epidemics were again created in the breeding cages at Njoro and the Scott Agricultural Laboratories by the pathological section. The natural form of stem rust present, K5, was, however, dominant, and the other forms utilized did not spread well.

Yellow rust was generally severe, and caused damage as low down as the 7,000 feet level. Leaf rust, whilst present, was not severe.

Other Diseases and Pests

Black chaff and glume blotch again damaged early-sown wheat in some areas, due to the wet conditions experienced at flowering and subsequently when the grain was filling.

"Take-all" is still present in some wheat fields, but on the whole this disease was not serious. Wherever possible, growers are practising some form of rotation as being the best method of control. Much "take-all" infected land at the higher altitudes has been planted with pyrethrum.

As stated above, locusts fortunately caused little general destruction of crops throughout the country, though a few individual growers suffered heavily.

Wheat Breeding at the Plant Breeding Station, Njoro

The appearance of the new race of stem rust (K5) in epidemic form this year has been of great value in providing a thorough test as to the behaviour of all the hybrid wheats to this form of rust. As was anticipated, most of the progeny of the older crosses showed susceptibility, but rust-resistant plants were obtained from the newer crosses made in 1935 and in succeeding years.

Most of the varieties in general cultivation showed susceptibility, amongst them being crosses No. 58, 500 and 503, 130, 131, NB. 230, Burbank, B.256.G, and Reward. Kenya

Governor and Golden Ball showed less susceptibility, as did Equator, whilst Sabanero was generally resistant. In addition, three varieties, of which there was only sufficient seed to plant a few hundred acres, were grown for trial and multiplication, as it was felt that these wheats might prove a useful stopgap against form K5. These varieties were:—

(a) No. 117.A (Njoro Hybrid x Marquis).—This strain has to date shown complete resistance to this form of stem rust, and in fact to all forms, though its resistance to form K3 was less marked. Growers reported favourably on it this season, and it remained entirely free of rust even when grown alongside other varieties which were completely rusted. It did not, however, meet with the best of luck, drought being responsible for the loss of two crops, and locusts and hail accounted for one each. Nearly two thousand bags of seed have nevertheless been harvested. This wheat is a medium early variety, suited to altitudes of from 6,000 to 7,500 feet. Its baking quality would appear to be only moderate, and it may be that the mills will only be able to deal with a limited acreage as is the case with Sabanero.

Wheat No. 117.A should not be confused with No. 117.I.5.F, which has been grown on a small scale and is susceptible to forms K2 and K5 of stem rust.

(b) Double Cross x Ceres 721.—This Canadian strain has previously shown some rust resistance, which was confirmed this season. At the medium altitudes it was in no case badly affected by rust, though at the lower altitudes infection was more severe in one or two cases. Two rust-free strains had been selected in 1937 and these two strains showed complete resistance to K5 this year. A number of further selections have now been made, and it is hoped that this wheat will be of use in the medium altitudes until one of the improved strains becomes available in bulk.

(c) Reliance.—Reliance has been in the Colony since 1930 but its growth has not been encouraged, owing to its susceptibility to rust form K3. When, however, it was found to be resistant to rust form K5 it was thought that it might be of temporary use. The crop this year remained free of rust, though under some conditions it did not grow well. It should prove useful so long as form K3 does not appear in epidemic form, but it is impossible to count on this in advance.

Two other wheats in course of multiplication, but of which only a limited number of bags are available, may be mentioned here:—

Australian 26.A (Kenya Standard x Baringa x Nabawa x Wandilla).—This Kenya–Australian hybrid bred in New South Wales has shown resistance to form K5 in the field and is accordingly being multiplied. In addition, it possesses strong straw, early maturity and some resistance to leaf rust. It is susceptible to yellow rust and black chaff, but has grown well at the lower altitudes, to which it is suited.

Simpson's Selected Strains.—In 1935, Mr. H. Simpson, of Rongai, found some natural hybrids in a crop of Kenya Standard which had not rusted when the main crop was destroyed by form K4 of stem rust. Selections were made out of this resistant material, and this year the best strains were increased. All these strains have fortunately also shown resistance to form K5, and have therefore become of particular value. One strain, due to its great susceptibility to yellow rust, has since been discarded, but the remaining two strains, known as Simpson's L.3 and Simpson's Rongai, are being increased over the short rains season. Both wheats are early maturing like Kenya Standard, and a preliminary baking test shows them to be in the "strong" wheat class. They are, however, susceptible to leaf and yellow rust, and are moderate yielders only. They are suited, like Australian 26.A, to the lower altitudes.

Amongst the wheats undergoing multiplication, of which only a few pounds of seed are available, the following may be mentioned:—

No. UX.9.M.1.A.9.2, a selection from an old Kabete hybrid, has shown resistance to all forms of stem rust, as has a further Kabete hybrid, No. 192.Q.2.A.(L). In addition, two Australian hybrids, No. Australian 45.C (Hope x Waratah) and No. Australian 69.A (Currawa x Hope), have shown sufficient resistance to form K5 to warrant their further multiplication.

Rust-resistant single plant selections of the F_3 and F_4 generations have been made out of the following more recent crosses:—

Cross No. 172—Njoro hybrid x Reliance.

Cross No. 223—DC.2303 x 112.E.8.L.5.

Cross No. 235—131.C.13.A.2 x DC. 2303.

Cross No. 289—DC. 2303 x 130.A.7.B.

Cross No. 261—68.E.12.A.1 x Reliance.

Cross No. 279—Reliance x 130.A.5.E.5.

Cross No. 280—Reliance x 112.B.11.(L.1)2.

Cross No. 285—Australian 26.A x 130.A.5.E.5.

In addition, a further series of single and double crosses, mostly in the F_2 generation, have been grown and rust-free selections have been made.

A series of new crosses made by Mr. Thorpe comprised amongst other wheats crosses with *Triticum timopheevi*, which wheat has shown resistance to all species of rust both this year and last year whilst under trial at Njoro and Molo.

Wheat Breeding at the Scott Agricultural Laboratories

The crosses grown here comprised:—

Cross No. 205—117.E.16.B.1 x 60.B.12.B.16.

Cross No. 284—Australian 26.A x 68.E.12.A.1.

Cross No. 291—Australian 26.A x 58.F.(L.1).

Cross No. 302—Australian 32.F x 68.E.12.A.1.

Crosses Nos. 205 and 302 were discarded, as in each case both parents showed susceptibility to form K5, but rust-resistant plants in the remaining two crosses were selected and harvested.

A number of crosses in the F_1 generation were grown on over the short rains of 1937–38 and re-crossed amongst themselves. Several acres of the two Simpson's selections are also being multiplied over the 1938–39 short rains.

Thanks are in particular due to Mr. Evans, Laboratory Assistant at the Scott Agricultural Laboratories, for growing these wheats under my direction and for carrying out all the routine seedling inoculation rust tests. Mr. Evans also created the artificial rust infections at Njoro and the Scott Agricultural Laboratories.

Molo Sub-station

One cross in the F_2 generation was grown on the Molo Sub-station; this was No. 296—Australian 26.A x 130.A.1.G.9, and plants resistant to form K5 and to yellow rust were harvested.

In addition, a number of imported wheats were tested for their behaviour to yellow rust at this high-altitude station.

It is with very real regret that the Plant Breeding Services record the death of Capt. C. T. Soames, on whose farm the Molo Sub-station is situated, and who did so much to support the work.

Yield Trials

The usual yield trials of the more promising wheats were again carried out at Njoro and Molo and on a smaller scale at Rongai and the Scott Agricultural Laboratories.

Australian-Kenya Hybrids

A further large collection was received from New South Wales. Unfortunately, all the wheats proved susceptible to the new form K5 of stem rust, but use has been made of some of them in crosses.

Canadian Wheats

Four new wheats in Coronation, Apex, Renown, and Thatcher were grown, together with Hope. Coronation, Apex, and Hope showed no rust. Renown and Thatcher showed a mixed behaviour, some plants rusting whilst others remained free. A further sowing towards the end of the season revealed some general rust on Coronation, whilst one or two Apex plants only rusted, the remainder being free. Both these wheats and selections in them will receive further trials. The later sowing of Hope showed a slight general infection, though a more severe infection was seen on this wheat at the Scott Agricultural Laboratories.

Grown at Molo, Apex alone showed some resistance to yellow rust, and this wheat is therefore of distinct promise, provided its susceptibility to black chaff under Kenya conditions is not too great.

Analyses of Baking Quality

The services of Dr. Kent Jones were again utilized, through the courtesy of Messrs. Unga Limited.

Mr. Noble carried out over three hundred Pelshenke tests on pure line and advanced hybrids.

Visits to Tanganyika Territory

At the request of the Tanganyika Government, the writer visited the Southern Highlands in June and the Northern Highlands in August to report on wheat growing in those areas.

Barley

The Prior barley imported from Australia was successfully multiplied over the short rains season and issued to farmers. This barley appears suitable where a quick-maturing type is required.

Of the slower maturing types, Spratt's Archer yielded the best, followed by the true type of Chevalier, obtained from the National Institute of Agricultural Botany, Cambridge. This latter type is being increased in view of the fact that it is not so slow maturing as Spratt's Archer.

Oats

The Australian variety Lampton again maintained its stem rust resistance at the high altitudes, though it was moderately attacked by stem rust at Njoro, where most of the other varieties rusted badly.

The Rhodesian strains S.E.S.52 and A.E.S. Kherson oat proved susceptible to stem rust at Njoro and Molo.

Maize Breeding

Sufficient seed of a large number of double crosses was available to enable two randomized block yield trials to be planted, one at Njoro and the other at Kitale. Damage by cutworm at Njoro, and by drought at Kitale prevented any statistical treatment of the results, but a number of the crosses yielded far in excess of the controls. Increases of up to 30 per cent were obtained at the former centre and up to 40 per cent at the latter. In view of these satisfactory increases it is proposed to repeat these particular crosses and subject them to further trials.

A further series of double crosses was made at Njoro and will be tested out in 1939.

The work at Kitale was carried out by the Agricultural Officer, under my direction.

The synthetic varieties at Kitale failed to show complete resistance to white blight, and further selections for this character will be done in them.

Pyrethrum

Clonal propagation of the best of the selected material was carried out at Njoro and at Molo. The main basis of selection was high pyrethrin content, though a number of high-yielding plants were also included, as were selections made by the Chemical Section at the Scott Agricultural Laboratories.

Seedlings from open pollinated seed from two high-content mother plants were planted out at Molo, together with seedlings from one low-content mother plant. Subsequent analyses of the flowers harvested both from the seedlings and from the mother plants were as follows:—

	PYRETHRIN CONTENT PER CENT	
	Mother Lines	Seedlings
High Content A	2.22	1.84
High Content B	2.34	1.78
Low Content	1.42	1.37

As was anticipated, the pyrethrin content of the seedlings from the high-content lines was lower than that of their mother plants, indicating that high content is not likely to be maintained by the use of open pollinated seed.

Clonal propagation of several lines was made and a number of flowers in each were self and open pollinated in order to see to what extent fertilization affected the pyrethrin content. Preliminary results indicate that the pyrethrin content is the same in each case, though the quantity of pyrethrins is increased in the case of open pollinated flowers, due to development of the achenes after fertilization. Further tests to confirm this are under way. It would appear therefore that two or more compatible lines are necessary when building up a plantation in order to obtain pyrethrin quantity as well as quality.

A breeding programme comprising hybridization of high-content lines was carried out. To avoid the need for covering the plants, since possibly this may have affected the development of seed in previous experiments, four plants of each of the two lines for the cross were planted together in situations isolated from other pyrethrum. Eight such crosses were arranged and viable seed has been harvested from most of them, indicating that most of the lines in the crosses arranged are compatible.

In addition, Mr. Thorpe artificially crossed these and other lines and obtained viable seed. All the above material will be grown on and the pyrethrin content of individual plants analysed through the assistance of the Pyrethrum Board.

Thanks are due to the Chemical Section for their co-operation in this work.

R. J. LATHBURY,
Plant Breeder.

PART VII—CHEMICAL SECTION
Annual Report of the Senior Agricultural Chemist
ADMINISTRATION AND GENERAL

Staff

The following staff changes occurred during the year:—

Mr. F. McNaughtan, B.Sc., Junior Laboratory Assistant, was appointed Agricultural Chemist (Pyrethrum) from the 1st January, 1938.

Miss M. G. Donald was appointed Junior Laboratory Assistant from 1st March, 1938.

Mr. S. B. Knowlden joined the staff as an unpaid learner from the 20th March, 1938.

The lack of a second senior chemist on the staff has definitely led to a loss of elasticity. While the laboratory assistants are able to conduct investigational work under direction it is very often impossible for a single senior officer to be able to give adequate supervision where most needed. For this reason it has been impossible to undertake the investigation absolutely necessary for the application of spectographic methods of analyses to agricultural problems. Although a great deal of the work involved is practically routine the preliminary work requires so much close supervision that it becomes very nearly a full-time job for the senior officer. Owing to the demands of other investigations, temporarily more important, it was not possible to spare the time. Therefore, when the East African Agricultural Research Station asked for the loan of the instrument, this request was acceded to. There is no doubt that we will benefit from their experience especially regarding the most suitable type of photographic plate to be used under tropical conditions.

Pyrethrum

The appointment of an officer specially to undertake pyrethrum analyses has been rendered possible by the generous contribution of the Pyrethrum Board towards this service. During the greater part of the year the officer concerned has been fully occupied in the regulatory analyses and has had very little time to undertake the necessary research work. The industry, realizing this need, has offered to pay for the services of two further chemists to meet its increasing demands for research and regulatory work. It is hoped that these appointments will be made early in 1939. The provision of adequate laboratory space for these officers may be a matter of difficulty.

The writer has attended in an advisory capacity several meetings of the Pyrethrum Board mainly in connexion with the subjects regarding the maintenance of quality. During the year an article was published on pyrethrum in the *Bulletin of the Imperial Institute*, and another in collaboration with Messrs. Gnadinger and Ireland in the *Journal of Industrial Engineering and Chemistry*.

Sisal

This year the writer has attended all the meetings of the Sisal Industry Committee, partly in an advisory capacity and partly in connexion with sisal research.

The High Level Sisal Experimental Station is now in course of establishment. Delay in starting unfortunately occurred due to the efforts which had to be made to overcome the opposition of certain coffee growers in the area. However, at the end of the year a considerable portion of the land needed for experimentation had been cleared of trees, a part has been ploughed up and planted to beans while the removal of short stumps, probably the most difficult part of clearing, is proceeding on the rest.

The work on the dam has proceeded apace and luckily was sufficiently far advanced for us to be able to conserve a good deal of the water flowing down the Samuru Valley. In fact the question of the water supply for the labour force became most acute just before the short rains. Both springs had decreased to mere trickles and it was impossible to obtain any water in the bed of the Samuru. It appeared that it would be necessary to obtain a water cart to meet the needs of the labour force but luckily rain fell and within two days there was four feet of water in the dam, completely solving the water problem.

Two roads have been constructed and a third is at present being surveyed. The building sites have been fully surveyed but owing to various difficulties it has not yet been possible to start the building programme. It is hoped to do so in the near future.

The thanks of the Department are due to the British East Africa Planting Company, Ltd., for the very great assistance they have given us in the research work on the retting of flume tow and other work connected with the preparation of fibres and for placing accommodation at the disposal of Mr. Pullen-Burry; also to the Anglo-French Sisal Company, Limited, for placing a house at Mr. Pullen-Burry's disposal, when staff

increase at the B.E.A. Planting Company necessitated his transfer and for placing their ploughing tackle and railway equipment at our disposal for work on the development of the Sisal Experiment Station.

Tobacco

The export of high nicotine content tobacco is now increasing. Since the price obtained depends directly upon the nicotine content it has become necessary for a large number of regulatory analyses to be undertaken.

General

The writer has attended several meetings of the Pollution Committee of the Water Board and has also served as a consultant.

In connexion with the passion fruit industry, suggestions for the proper hygiene of passion fruit factories were drawn up and circulated to the various factories. Apparently these suggestions met with the approval of the industry since at their request very stringent rules have been submitted. These rules should make a considerable difference to the keeping qualities of passion fruit juice.

The writer also attended the Nakuru Show where he was consulted to a considerable extent by farmers. In the course of their duties members of the section travelled a total of about 8,000 miles.

Finally, there remains the pleasure of recording the local assistance of subordinate officers who have carried out much of the field and laboratory work involved. Mr. F. McNaughtan, who was appointed Agricultural Chemist (Pyrethrum) at the beginning of the year, has been responsible for the carrying out of the very numerous routine assays required for the purpose of the guaranteed analyses and has co-operated in the general pyrethrum investigational work carried out. Mr. McNaughtan and Mr. R. O. Barnes have incorporated further improvements in estate pyrethrum-drying and have now evolved the Modified Ainabkoi Pyrethrum Drier. Mr. Barnes prepared a set of working drawings of this drier which are now available to growers. Mr. Pullen-Burry has co-operated in the establishment of the High Level Sisal Experiment Station at Thika and has worked on the retting of flume tow and the more complete utilization of the sisal plant. Miss M. G. Donald, Junior Laboratory Assistant, has carried out the laboratory work in connexion with soil nitrification in parallel

with bacterial counts done by Mr. F. Evans of the Plant Pathology Section. Mr. C. T. Dewar, Junior Laboratory Assistant, has assisted in the routine analysis of pyrethrum. Mr. S. B. Knowlden, who joined the staff as an unpaid learner during the year, has proved himself to be efficient over a wide range of chemical laboratory work.

INVESTIGATION

Work Done

The number of samples examined this year is considerably higher than that for last year. The character of the samples is given below in tabular form:—

NATURE OF SAMPLE	Pending 31-12-37	Received	Exam- ined	Refused	Pending 31-12-38	Total
Soils.. ..	—	214	202	—	12	214
Fertilizers ..	—	20	20	—	—	20
Waters ..	—	8	8	—	—	8
Pyrethrum ..	11	236	229	9	9	247
Tobacco ..	7	53	60	—	—	60
Miscellaneous	—	34	34	—	—	34
	18	565	553	9	21	582

Soils

A good many of the samples of soil were brought in by farmers in conjunction with advisory work but a great proportion were taken in connexion with investigations.

It was not possible to follow up in detail the nitrification work mentioned in last year's report. However, fortnightly samples were taken in the field to study the variations of ammoniacal and nitrate nitrogen throughout the year.

As was anticipated immediately after the beginning of the rains there was a very marked increase in the ammoniacal nitrogen followed by a rise in the nitrate nitrogen, the latter form, however, with continued rain was very rapidly leached out from the surface soil.

As the rainy period continued the rates of ammonia formation tended to decrease and had it been possible to ascertain the total nitrate formation it is highly probable that here too the decrease in the rate of formation would have been observed. This decrease in bacterial activity is probably due to an increase in the numbers of protozoa.

An attempt was made to follow the variations in bacterial numbers. The technique at our disposal, although giving interesting results, is not sufficiently accurate to permit of us drawing definite conclusions. Arrangements have therefore been made for an officer to spend next year a period at the Rothamsted Experimental Station in order to become familiar with the latest technique. On his return parallel work of the variation in ammoniacal and nitrate nitrogen and in bacterial numbers will be continued over a whole year.

Meanwhile it is intended to explore a technique whereby it will be possible to determine accurately the bacterial activity in the soil.

This work sounds rather academical: it is not, but is very practical. It is an attempt to ascertain the real reason for the difference between the results obtained from early and late planting. It is possible that a proper understanding of the reasons for these differences may enable us to suggest modifications in farming procedure.

A large number of soil samples were taken from the Nandi, Kaimosi and Kipkarren districts in order to determine the areas which would be most suitable for tea planting. The results obtained indicate that part of the Nandi District and the Kaimosi District are very definitely suitable for tea. There is an uncertainty regarding the rest of the Nandi District and it has been suggested that one or two small plots be laid down before serious planting is undertaken.

As regards the Kipkarren District, the conditions here are variable. Some of the soil samples indicate that there has been a marked change in the soil climate: when the soils were first formed they were well drained but since then there has been a complete alteration with the development of a typical impeded drainage soil. These soils are unsuitable for tea planting. Other soils are more suitable for mixed cereal and stock farming than for any other form of farming. It is only here and there that the soils could possibly be regarded as suitable for tea planting. A similar survey has been extended to the North Sotik and Kericho areas but is as yet incomplete.

Fertilizers

The number of fertilizers submitted this year remains about unchanged. A few samples were submitted by importers of Seychelles guano, the rest were mainly composts, and again it is regretted that most samples still contain too great a proportion of admixed soil. The possibility of promulgating an

Ordinance regulating the sale of fertilizers has been considered. It is believed that such an Ordinance is desirable and could be administered without an increase in staff for a few years.

Waters

As in previous years all the samples of waters submitted were in order to ascertain their suitability for agricultural purposes. There is nothing of interest to report in this connexion.

Pyrethrum

The sale of pyrethrum under a guarantee has led to an enormous increase in the number of samples analysed.

All samples taken from export bales are assayed in duplicate which means in reality that something like 400 assays have been made. The method of analysis employed at the Scott Agricultural Laboratories is the Gnadinger-Corl copper reduction method. There has been a good deal of criticism levied at us for using this method. It is stated to be inaccurate, difficult to use and laborious. Experience with the Tattersfield short acid method, the Seil method and the modified Seil method in which ethyl acetate is used for extracting the pyrethrin II constituent has confirmed in our opinion that this method is as accurate as any other, is no more difficult and requires very much less apparatus and space, the latter being a great consideration in the Scott Laboratories. There is one difficulty however, namely that the glass of the bulbs of the special tubes employed is attacked by the solution and becomes very difficult to clean. This leads at times to very variable figures necessitating a replication of the analyses. In order to obviate this difficulty we are attempting to have the special tubes made of Monax glass, a glass very resistant to caustic soda solutions.

At the beginning of the year the pyrethrin content of the general average of Kenya pyrethrum dropped to just about the guaranteed limit and occasionally went below this. This low pyrethrin content continued till the end of June. From the beginning of July till the end of October the pyrethrin content was very satisfactory, but at the beginning of November another drop occurred.

Owing to lack of staff it was not possible to investigate the reason for this drop. It was thought at one time that it may have been due to inaccuracies in sampling but this idea was completely disposed of by a series of analyses on parallel samples drawn in two ways. One opinion is that the drop is due to growers not cutting back in the dry season and so

resting their plants. Instead, on account of the high prices obtaining, the plants are forced to continue flowering, even though the yield is low. Experiments at the Scott Agricultural Laboratories over the last two years have shown that there is a progressive drop in pyrethrins as the season advances. Forcing the plants to continue cropping produces the effect of a long flowering season. The desirability of cutting back is recognized by all the best growers but most probably it is expecting a great deal from those who have recently entered the industry to give up a crop which might be worth £10 to £15 per month. The present very high price, 80 cents per lb., for first grade material must be considered partly responsible for this attitude.

Another suggestion is that bad drying is responsible for a great deal of the decrease in pyrethrin content. There is no doubt that there is a very great deal of carelessness in the drying of pyrethrum. Many examples have been seen of scorched flowers, of flowers which can be called stewed, black and evil-smelling. While appearance is no longer the criterion of quality it was five years ago it must however be remembered that a good appearance does indicate care in preparation and the odds are that the better looking sample is the better in every way.

If Kenya pyrethrum loses the most enviable reputation it holds to-day, it will be due to carelessness on the part of the growers; not all, but that small proportion who will not take the necessary care to produce a first class article. At to-day's price it is easy for growers to install all the necessary appliances to ensure a really first grade article. Pyrethrum should not be regarded as a milch cow to supply the needs of the rest of the farm. In this connexion the rates of payment decided upon by the Pyrethrum Board should go a long way towards convincing growers of the need for care and proper preparation.

While still on the subject of drying, attention must be drawn to the habit of pyrethrum growers of altering the carefully worked out plans developed by two people who have made an exhaustive study of the matter. Last year, as a result of collaborative work between Mr. R. O. Barnes and Mr. F. McNaughtan, a modified Ainabkoi drier was evolved, and very complete working plans were produced by Mr. Barnes. Quite a number of driers have been built, according to the owners, exactly to these plans, but nevertheless complaints have been received that the design is inefficient. On investigating the

question it has always been found that the builder has made some modification of his own, generally reducing the ventilation. The layman believes it is heat alone that dries, whereas, in fact, it is warm air that does so. In every case where the ventilation has been adequate at construction or increased later to that of the design, efficient drying has always been obtained. Granted that in one or two cases results pleasing to the builder have been obtained, but do the results satisfy the grader? One so-called Ainabkoi drier, it is claimed, dries 2,000 lb. of wet flowers per day. This drier has no ventilation either top or bottom, except what seeps in and out of cracks. What is happening is an internal circulation of air, in truth very economical of fuel, but the flowers subjected to protracted wet heat suffer a severe fermentation and more than 50 per cent of them are black, very definitely not a first grade product. This "success" was obtained by not following details other than that of ventilation in construction; in fact, it is understood that before the ventilation was cut off the drier was most efficient. It was built with a space behind the trays which acts as a chimney and which now provides the re-circulation.

With these examples before us, it is evident that in the rules under the new Pyrethrum Industry Ordinance some provision must be made to ensure that growers do build their driers according to approved designs and no longer make unnecessary costly experiments.

Possibly this is the best place to make the statement that the properly built Ainabkoi drier is very efficient, produces five to six bags of dried flowers, perfect in colour, daily, and owners of such driers are loud in their praises.

A survey of the pyrethrum-growing districts was planned for this year and a number of growers were asked to co-operate. Not many did so wholeheartedly; perhaps fortunately, in view of the very large number of analyses which had to be made during the year and which would have made it very difficult to meet all the demands. The results obtained in this district survey are therefore not conclusive, and it is hoped that when the staff for pyrethrum work is increased it will be possible to conduct this district survey on very much wider lines. It would appear, however, that the two best districts for pyrethrum are Nyeri and Nakuru. Flowers from both these districts contained on the dry material at the beginning of the season about 2 per cent total pyrethrins, which content decreased as the season progressed. In no case was the pyrethrin content of flowers at the beginning of the season less than

1.73 per cent. The lowest figure obtained in the series of analyses made was 1.47 per cent on flowers from Nyeri at the very end of the season.

With these figures before us, the very low pyrethrin content of the average pyrethrum appears even more inexplicable. In this district survey probably we have been dealing with the most careful and painstaking of the growers.

As much assistance as possible has been given in the selection and breeding work on pyrethrum. Of twenty-seven lines of pyrethrum, eight have been chosen with a pyrethrin content of over 1.40 per cent; a further eight with a pyrethrin content of over 1.30 per cent are also being retained. The pyrethrin content of some of the lines selected is very high indeed, two of them approaching 1.80 per cent.

There is very definitely a need for selection work. The strain normally grown at the Scott Agricultural Laboratories has been selected year after year and, as a whole, produces very large flowers. This was thought to be due to local climatic conditions, but last year a small plot was planted out with seedlings derived from the ordinary run of seed available in Kenya; the flowers from these are less than half the size of the general run of the Scott Agricultural Laboratories strain. Continuous selection has given us an outstanding strain as regards size; the pyrethrin content, too, is very satisfactory. Eleven selections have been made from our mature plot of the S.A.L. strain; the best plants have been sent to the Plant Breeding Station, Njoro, for vegetative propagation, while seed is taken from the others and also sent there. Properly to do this work it is essential that the produce of each selection be analysed at intervals to ensure that no strains of poor content creep into the final selection, and it is for this reason that the Pyrethrum Board is desirous of increasing a staff of chemists engaged on pyrethrum work.

Plots of pyrethrum to study the effect on age of plants are being established each year.

Tobacco

The growing of high nicotine content tobacco, to be used for the preparation of insecticides, is now fully established as a small industry. Since the price obtained depends directly upon the nicotine content, analyses of individual consignments are necessary. The ordinary method of analysis, involving distillation in steam, is slow and liable to give non-concordant results, therefore the method accepted as "official" by the

American Association of Official Agricultural Chemists, involving precipitation with silico-tungstic acid, was employed at the beginning of the year. As the number of samples received increased, especially as some twenty-four were received in connexion with selection work in one lot, it was evident that, if we were to keep up with the flow of samples, some simpler, cheaper and quicker method would have to be employed. A comparison of various methods of analysis was made, and finally the Keller method was settled on. This method is very quick, is cheap, and above all gives results very nearly identical with those obtained by the long and complicated silico-tungstic precipitation. It is possible that there may be slight errors, but the order of these errors will not affect the price of the tobacco, and in comparison work are of no importance.

As mentioned in my last annual report, the selection work on tobacco has been carried out with plants derived from seed of the best plant grown at the Scott Agricultural Laboratories in 1937. Twenty-four plants were selected. The nicotine content of these varied from 10 per cent to 15.4 per cent; these figures calculated on the dry basis. Of all the plants only those with a nicotine content of over 13 per cent have been retained for seed production. Results so far have been most promising, but it is very certain that this work will need a very great deal of chemical assistance.

As regards the commercial samples, it is interesting to report that at the beginning of the year the nicotine content was comparatively low, but towards the end of the year some very high figures indeed have been obtained, two samples containing, on the dry basis, 14.8 per cent and 14.9 per cent. Growing such material, which will be worth approximately 7½d. per lb. in London, is certainly going to be very profitable.

Sisal

The investigation of the retting of sisal flume tow has proceeded, and may now be considered to be complete. In this connexion it was essential to evolve a washing machine; a full scale model of it was built and found to be quite satisfactory. A confidential report describing the whole process in detail has been submitted to the Kenya Sisal Growers' Association.

This work has led to an investigation of the more complete utilization of the sisal plant, some of the lines of which involve retting. Some very interesting products have been produced which, while still in the experimental stage, have aroused great interest in the fibre trade. A machine has been

evolved for the production of fibre from the dry leaf butts remaining on the dead poled plants. These fibres promise to be of value in the upholstery trade, and it is understood aroused great interest at Lambeg.

Experiments have been made (with the very kind assistance of Mr. R. H. Paige, to whom our thanks are due) on the utilization of sisal fibres of various types as a reinforcement in concrete. The results so far have been highly interesting and promise to be valuable. Plans have been drawn up for the use of some of these materials in the construction of the house for the African staff of the Sisal Experiment Station.

Work on the establishment of the Sisal Experiment Station has been discussed in the first part of this report.

Essential Oils

There has been very little investigational work on essential oils during the past year. The production of lavender oil is now a commercial proposition, and one or two samples have been analysed. At last the exploitation of *Cymbopogon afronardus* has reached a commercial stage, and samples of the first oil are expected early in 1939.

Miscellaneous

Amongst the items falling under the grouping of miscellaneous lie a number of small investigations.

At the request of the Veterinary Laboratory a sample of Croton oil was prepared from the indigenous *Croton megalocarpum* for trial as a substitute for the imported oil.

A small investigation was made into the removal of the bitter material in the skin of the kernel of the Kweme nut. Working on parallel lines to Amani, this was found to be a simple process; simple steeping in water for from two to five hours was found sufficient to remove the bitterness. The results obtained at the Scott Laboratories are not in complete accordance with those obtained at Amani, but it is possible that we were working with nuts that contained less of the bitter material. A large quantity of nuts was prepared for a trial on methods of export involving various forms of packing.

In connexion with the locust campaign, the demand for the antidote to arsenical poisoning very soon exhausted our stock of ferric chloride, and it became necessary to produce a material from iron turnings. In all, some 20 lb. of ferric chloride were produced in the laboratories.

V. A. BECKLEY,
Senior Agricultural Chemist.

PART VIII—ENTOMOLOGICAL SECTION

Annual Report of the Entomologist in Charge

Plant Legislation

During the year the orders and rules under the Plant Protection Ordinance, 1937, were redrafted. The most important alteration is the withdrawal of all regulations governing the movement of foreign coffee within the territory. Experience over a number of years has shown that the Scolytid, *Stephanoderes hampei*, has little chance of establishing itself as a serious pest of coffee in the more important coffee districts within the Colony. To allow free movement of coffee from neighbouring territories will greatly facilitate trade in such coffee on the Nairobi market.

Import

Permits issued for the introduction of plants and plant products during the year numbered 451. The numbers issued for the previous year were 295.

Export Certificates

During the year 78 certificates of inspection were issued for plants and plant products for exportation from Kenya.

The following were intercepted in plant importations:—

BOSTRYCHIDÆ :

Dinoderus minutus, F. In bamboo pots containing various *Hibiscus* species from Fiji.

SCOLYTIDÆ :

Xyleborus coffeæ, Wurm Boring in orchids from Queensland, Australia.

This Scolytid is a fairly serious pest in Java and Madagascar, where it bores the smaller twigs of coffee.

Stephanoderes hampei, Ferr. In coffee (*Excelsa arabica* hybrid). Uganda

DYTISCIDÆ :

Bidessus sordidus, Shp. Orchids. Queensland

BRUCHIDÆ :

Bruchus chinensis, Linn. Beans. India

APHIDÆ :

Cerataphis lantaniæ, Bdr. Orchids. Queensland.

COCCIDÆ :

<i>Hemichionaspis</i> , sp.	Orchids.	Queensland
<i>Lepidosaphes</i> ? <i>tuberculata</i> , Leon ? . .	Orchids.	Queensland
<i>Chionaspis</i> sp.	Orchids.	Rio de Janeiro
<i>Conchaspis</i> sp.	Orchids.	Canal Zone
<i>Furcaspis</i> sp.	Orchids.	Canal Zone
<i>Pseudococcus citra</i> , Risso	Probably aerial and root forms.	Banana suckers. Uganda
<i>Lecanium</i> sp.	Coffeæ	Khasiana. Tanganyika
<i>Lepidosaphes beckii</i> , Newm.	Citrus.	Tanganyika
<i>Lecanium</i> sp.	Orchids.	Ceylon
<i>Lepidosaphes</i> sp.	Citrus.	Tanganyika

FORMICIDÆ :

<i>Monomorium</i> (<i>Parholcomyrme</i>) <i>destructor</i> , Jard.	Present with orchids from	Queensland
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Ants, unidentified Peta leaves. Penang

MITES Citrus. Tanganyika

PEACH STONES : Their importation is prohibited and consignments imported were destroyed on arrival. Two consignments of plants packed in soil were also destroyed on arrival in Mombasa.

Mealy Bug

It is pleasing to record the confirmation recently obtained by members of the Coffee Team of my opinion, held since the original outbreak of mealy bug in 1932, that *Pseudococcus kenyæ* is indigenous to Eastern Central Africa.

The discovery of internal parasites of this mealy bug in Uganda by Mr. Melville and their successful breeding by Dr. Le Pelley and his co-workers at the Scott Agricultural Laboratories is a tremendous advance in the efforts made to control *P. kenyæ* by biological means.

The rapidity with which these parasites are breeding under the climatic conditions of the Central Province of Kenya and the fact that *P. kenyæ* occurs in a well-defined ecological island within the Province augurs well for the eventually successful control of this serious insect pest of coffee.

Maize Stalk Borer (*Busseola fusca* Fuller)

No reports were received during the year of this pest causing damage to maize and sorghums. The dry weather experienced during the latter months of the year and early in 1939 caused maize to ripen off rapidly and facilitated harvesting. This should enable farmers to remove all maize stalks several weeks before the planting of the 1939 crop commences and attacks of stalk borer during 1939 may be expected to be slight.

Thrips tabacci Lind. and *Pyrethrum*

This insect has a wide host range within the Colony and is present on pyrethrum plants (*Chrysanthemum cinerariifolium*) on all estates so far examined where this plant is being grown. Until quite recently pyrethrum was grown at elevations from 7,000 feet upwards, but owing to the high price obtained for the flowers cultivation of the crop is extending to areas where yields per acre are considerably reduced and which in normal times would be considered uneconomic.

Though the plant will grow under a wide range of conditions, the highest yields are obtained at altitudes over 7,500 feet, where the rainfall is not too high but fairly evenly distributed and where, from a cultural point of view, the climate is "cool". It is significant that the areas from which the highest yields are obtained are also the areas in which *Thrips* has not yet appeared in epidemic form.

In arriving at general conclusions from field observations there is no doubt that the cooler the situation of a plantation, until the zone of frost is reached the less liable is it to severe infestations of *Thrips*, and such situations are definitely favourable to pyrethrum cultivation.

No evidence has been adduced that soil types play any significant part in determining population densities of this insect.

The variability of the rainfall in the several districts where *Thrips* has appeared in epidemic form indicates that soil moisture conditions are not of primary importance in favouring outbreaks. In the absence of controlled experiments little can be said about the exact effect of climatic factors on the population of *Thrips* in pyrethrum, though it would appear that temperature is probably the most important single climatic factor influencing population density. It has been noticed that in areas at lower elevations where the daily temperatures are high, and at elevations around 7,000 feet where the average daily temperature is higher than what may be termed normal for such elevations due to local influences of topography, such areas suffer from severe infestations of *Thrips tabacci*.

There is also negative evidence to indicate that rainfall and humidity do not play an important part in the development of outbreaks.

Details in the life-history have not been worked upon. From observations in the field it would appear that the whole life-history, from egg to adult, takes only about three weeks in the warmer months September to February. From March to August the pest does not appear much in evidence in any area. Eggs have been found in the stem and leaf of the pyrethrum plant but not in the flower.

The adult is usually found in the pyrethrum flower and is seldom found on the leaves until present in large numbers.

The immature stages are usually to be found on the under-surfaces of the leaves and in the flowers, and finally on the stem in cases of severe infestations.

When a plant is badly attacked silvering of the leaves and stem takes place and these later turn brown and appear dry. The damage observed by the pyrethrum grower is a browning of the ray florets of the flowers, which results in these flowers being de-graded. The browning and spotting of the flowers as a result of Thrips attack is due to the entrance of the fungus *Alternaria gossypina* (Thum) Hopkins. Under conditions of high humidity the fungus spreads rapidly, and browning may be very severe. The fungus sporulates freely in the field and under favourable weather conditions may attack the florets in the virtual absence of Thrips. Most severe discoloration takes place after heavy falls of dew or immediately after the advent of rain provided the temperature remains fairly high. On a rapid fall in temperature browning practically ceases.

On light volcanic soils which dry out rapidly during the hot dry weather, the effect of Thrips infestation is aggravated and the pyrethrum plants appear wilted and may produce only few and small flowers at this period.

Control

It is most important that regular inspection of the crop should take place in order to discover initial outbreaks. When such an outbreak is discovered, spraying with nicotine sulphate (40 per cent nicotine) diluted 1 : 500 or with proprietary lime sulphur 1 : 80 is recommended. In cases of severe infestation spraying is considered to be uneconomic since it must be repeated at fortnightly intervals. In such cases the plants should be cut back and sprayed with either of the above mixtures. Since there are large areas within the Colony where pyrethrum is grown successfully practically free from Thrips, it is the writer's opinion that the play of economics will determine the Thrips-infested areas to be unsuitable for the successful production of pyrethrum.

*Locusts**Nomadacris septemfasciata* (Red Locust)

Two medium-sized swarms, six miles by three miles, of the Red Locust entered North Kavirondo from Tororo, Uganda, on the 15th and 19th of May respectively. These swarms split into smaller ones, which engaged in circular flights visiting various areas in North and Central Kavirondo, the Trans Nzoia, the Kibigori-Muhoroni Valley, and the Nandi country. During their sojourn within the Colony very slight damage to crops took place and no laying occurred. By the first week in July the small swarms had either returned to Uganda or had been destroyed by diseases and pests, and the Colony became for a time entirely free of locusts.

Locusta migratoria migratorioides (Migratory Locust)

In a letter dated the 21st July from Sir Guy Marshall, Director of the Imperial Institute of Entomology, it was stated that if the summer rains in the Sudan were favourable for breeding there was a danger of the appearance of swarms of the Migratory Locust in North Kenya after September-October. No sooner was this letter received than telegraphic information showed that huge swarms were entering Northern Turkana from the north-west in the Sudan. Between the 27th July and the 23rd August several large swarms entered the Colony direct from the Sudan on our north-western boundaries. Invasion thus took place at least one generation earlier than was anticipated. These swarms proceeded either in a south-easterly direction until they arrived in the Mukogodo-Isiolo area or proceeded south into the Kerio Valley or slightly west of south until they arrived in the vicinity of Mount Elgon. Their subsequent movements within the Colony were then determined by local topography and the locusts kept generally to the various valleys encountered. Migration thus continued through the dry desert areas of the Northern Frontier Province until the locusts arrived in areas where food supplies were plentiful. So far as is known, only one swarm, ten miles long by one mile wide, entered the territory through Uganda, probably through Karamoja and around the western slopes of Mount Elgon.

Mukogodo-Isiolo Area.—Flying swarms arrived in this area between the 4th and the 12th of August. They remained within the area for about one month, feeding and circling around, during which time they visited Meru, Timau and Nanyuki. Little damage to crops took place, though several

fields of wheat were destroyed. From the beginning of September to the middle of the month migration commenced, first to the east through Meru and then to the south, until the whole of the above area became free of locusts. The swarms passed on through Embu, Fort Hall, Thika, Ruiru, Nairobi, and into the Rift Valley. On entering the Rift Valley the majority continued their southerly migration into Tanganyika, and none of these swarms laid within the Colony.

Mount Elgon.—The first swarm arrived on the eastern slopes of Mount Elgon on the 26th August, and further swarms continued to arrive until the 19th September. These spread into North Kavirondo and all over the Trans Nzoia and Uasin Gishu Plateau.

Kerio Valley.—Swarms from the Kerio Valley overflowed into the Baringo Valley and the Kamasia Reserve, and spread into the districts of Ravine, Rongai, Subukia, Solai, Njoro, Nakuru, and further south to Lake Naivasha from the 5th August to the end of October.

Egg-laying took place over wide areas within the Colony and hopper infestation was severe in certain districts. The heaviest infestation occurred in the Trans Nzoia and Uasin Gishu districts, and the infestation in this area was more severe than that of the 1931 infestation.

Owing to differences in climatic conditions in the several areas invaded laying commenced at different times. In the Nyanza and Nzoia Provinces laying commenced at the beginning of October, whereas in the Nakuru Province laying did not occur until the first week in November.

As a result of observations made in the field evidence has been obtained which clearly indicates that the various swarms laid at least four times and most probably five and six times, at intervals of eight to twelve days. This resulted in very large areas being laid over by each individual swarm and progressive hatching over a period of some two months.

Owing to the relatively short incubation period in this Colony (fourteen days and upwards, according to elevation), there is not sufficient time to adequately prepare for a large campaign once laying has commenced. Preparation for such a campaign should commence as soon as the flying locusts have ceased migration and commenced their circular flights within a particular area and when regular dissection of locusts reveals that ovarian development is rapidly taking place. This increases the time for preparation by at least three weeks, even

under the most favourable climatic conditions. It cannot be too strongly emphasized that the first essential for a successful anti-locust campaign is to be fully prepared with material and an efficient organization before hoppers commence to hatch.

During the present invasion Government was advised to commence preparations for a hopper destruction campaign on the 6th September. Egg-laying first commenced on the 1st of October, and the first hatching took place on the 22nd October. This period of slightly more than six weeks enabled Government to be fully prepared with adequate supplies of bait and spray material, to put into operation an efficient organization and to deliver supplies to the areas concerned by the time hoppers emerged. This preparedness and the efficient anti-locust organization has resulted in the campaign being a complete success and relatively few hoppers escaped destruction. It can be proved that over 99 per cent of eggs and hoppers were destroyed at a much lower relative cost than in any previous campaign undertaken in the Colony. As several payments are still to be made, the actual cost to Government of this campaign cannot be accurately stated, though it is anticipated to be less than £10,000.

The results obtained with poison bait have demonstrated beyond doubt that baiting is by far the most efficient and economic method yet known of destroying locust hoppers in Kenya and that when properly distributed constitutes no danger to stock. Owing to the low state of intellect of certain native tribes it is not always possible in practice, even under adequate supervision, to distribute poison bait properly and loss of stock may result. A single case of stock poisoning occurring, soon becomes known and has a tremendous psychological influence on stock farmers, which increases the difficulties of a locust officer out of all proportion to the loss incurred. This difficulty has been met to a certain extent by Government promising to pay compensation for loss where it can be shown that all reasonable steps have been taken to distribute poison bait as recommended. It is probable that the fear of and loss from poisoning as a result of baiting may be eliminated entirely if a simple method can be devised to eliminate certain lumps from the bait before distribution.

In the present campaign preparation and mixing of bait according to a standard formula supplied by Government was undertaken by a commercial firm at a central factory and bait was delivered free on rail at a cost of Sh. 6 per ton; the arsenic was supplied by Government. This arrangement has proved

eminently satisfactory and the firm is to be complimented upon the excellent manner in which it has carried out the work at so reasonable a charge.

During the campaign 5,880,000 lb. of bait were mixed of which 4,524,800 lb. were issued. Of this quantity 3,734,000 lb. were used in the Nzoia Province. Before the campaign commenced Government was informed that a minimum of 1,900 tons of bait would be required and it is interesting to note that 2,019 tons were actually issued.

Outlook for the coming year.

At the time of writing it seems probable that the Colony will not be invaded by swarms direct from the Sudan. Three or four relatively large swarms of *L. migratoria* have entered North Kavirondo from Uganda. These have broken up into smaller swarms which have commenced circular flights in North and Central and South Kavirondo. The locusts are at present immature and it is not possible to state when laying will commence, though laying may be anticipated within the above districts soon after the advent of the rains in March. Should a further campaign become necessary it seems probable that it will be on a smaller scale than the one reported above.

Acknowledgments

It is with great pleasure that I record the thanks of the Entomological Section due to the locust control officers and all voluntary workers for the onerous duties undertaken by them and to all who assisted by their co-operation in bringing the campaign to a successful issue. I can imagine little that is more depressing than fighting locusts and to everyone who assisted in whatever capacity my thanks are due.

A special word of thanks is due to the officer commanding the Northern Brigade of the King's African Rifles for the loan of transport and of a full company of men and European officers. This disciplined body of men did splendid work and contributed largely to the success of the campaign in the Nakuru area.

Locust Research

The search for less poisonous substances than arsenite of soda was continued but no substance has yet been found which is efficient and cheap enough to warrant Government adopting it in the standard bait. Tests were carried out with calcium chloracetate, a substance supplied by the Imperial Chemical Industries and which is said to be less poisonous to animals and birds than arsenite of soda. The substance is difficult to

get into solution and its effect on locusts was so variable that it cannot be recommended.

Various strengths of tobacco extract were tried and while $\frac{1}{2}$ per cent solution is reported to be effective against young hoppers, first and second stadia, it proved useless against older hoppers.

Good results were obtained by spraying with a 5 per cent solution of soft soap, or blue-mottled soap, but the cost is high, a fact which prohibits its use except under very special circumstances such as in paddocks grazed over by high grade stock or on a very limited scale. The hoppers need to be well wetted with the spray and on one acre of hoppers 300 gallons of water need to be used. Used at this rate the cost of soap alone is Sh. 27 per acre which is prohibitive.

Termites

Termes badius, Hav. and *Termes bellicosus*, Smeath. Extensive baiting experiments were carried out using *Podocarpus* sawdust treated with molasses and calcium chloracetate. No success was obtained and the results were very disappointing considering the reports received on the efficacy of this substance when used against ants in Britain.

Fumigating the nests with arsenic and sulphur or digging out the nests completely when these are accessible provides a very high degree of control.

Borers

The Cerambycid, *Oemida gahani*, Dist. found in *Podocarpus gracilior* is becoming a serious menace to the timber structure of many of the earlier buildings in Nairobi. The effects of this borer have not been noticed until quite recently and in some cases joists and roof supports have been so seriously damaged that their safety limit has been reached. In the case of one large hotel the results of the work of this beetle have necessitated structural alterations costing several thousand pounds sterling. The insect appears to confine its attacks to the one timber *Podocarpus gracilior*. The exit holes made by the adult are small, varying in size from 2 mm. by 1 mm. to 5 mm. by 3 mm. Treatment with ordinary wood preservatives appears to have no effect. Owing to the small size of the holes made by this borer injection of materials into the timber in situ is laborious and it is fortunate that the mentality of the African lends itself to this form of control where great patience is needed. Injection of small amounts of solution of paradichlor-benzene followed by plugging the holes with putty has been relatively successful.

ADDITIONS TO THE LIST OF INSECTS RECORDED IN THE COLONY

COLEOPTERA :

- Carabidæ*
Chlœnius antennatus, Chaud.
Melolonthidæ
Ablaberoides bohmi, Qued.
Schizonycha sp.
Aserica sp.
Rutelidæ
Adoretus pagenstecheri, Gerst.
Tenebrionidæ
Phrynocolus auriculatus, Geb.
Curculionidæ
Blosyrus vestitus, Fairm.
Mitophorus pilosus, Hurst.
Systates nigrinus
Galerucidæ
Apophyllia keniaensis, Lab.
Hispidæ
Dactylispa sp. near *tenuicornis*, Chap.
Cassididæ
Acrocassis soror, Wse.
Cistelidæ
Allogista serrinula, Borch.
Allogista subparallela, Borch.
Allogista fortepunctata, Borch.

HYMENOPTERA :

- Formicide*—*Leptogenys (lobopelta) brevicornis*, Sants., var. *deflorata*.
Bothroponera kenyensis, Sants.
Cataulacus donisthorpei, Sants.
Crematogaster (Orthocrema) jeanneli, Sants.
Engramma ilgi, F.
Agaonidæ
Sycophaga sp. near *sycomori*, L. Wild fig

ISOPTERA :

- Pseudocanthotermes militaris*, Hag.

THYSANOPTERA :

- Dolichothrips* sp. (Custard apple)

RHYNCHOTA :

- Lygæidæ*
Ozycarenius sp. on *Sida schimperiana*
Asphanus nigrellus, Dist. On coffee
Asphanus sp. On coffee
Orthœa sp. On coffee
Tingitidæ
Genus ? sp. On *Cordia holstii*
Cicadidæ
Ugada limbata, F. on Blue Gum

Visitors

It is pleasing to record a large increase in the number of planters who visited the laboratory. Also His Excellency the Governor, Sir Robert Brooke-Popham, the Chief Colonial Secretary, Sir Armigel Wade, the Chief Native Commissioner, Mr. Hosking, Mr. A. G. Hill, Director of the E. A. Agricultural Research Station, Amani, Mr. Waller Carter, Honolulu, Mr. S. T. Platt, Medical Research Council, London, Mr. S. Crawshaw, Overseas House, London, Mr. D. Makepeace, London, Mr. D. Vesey Fitzgerald, Entomologist, Seychelles.

H. WILKINSON,
Entomologist in Charge.
